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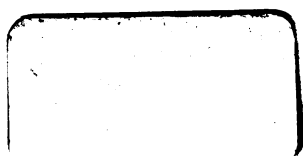
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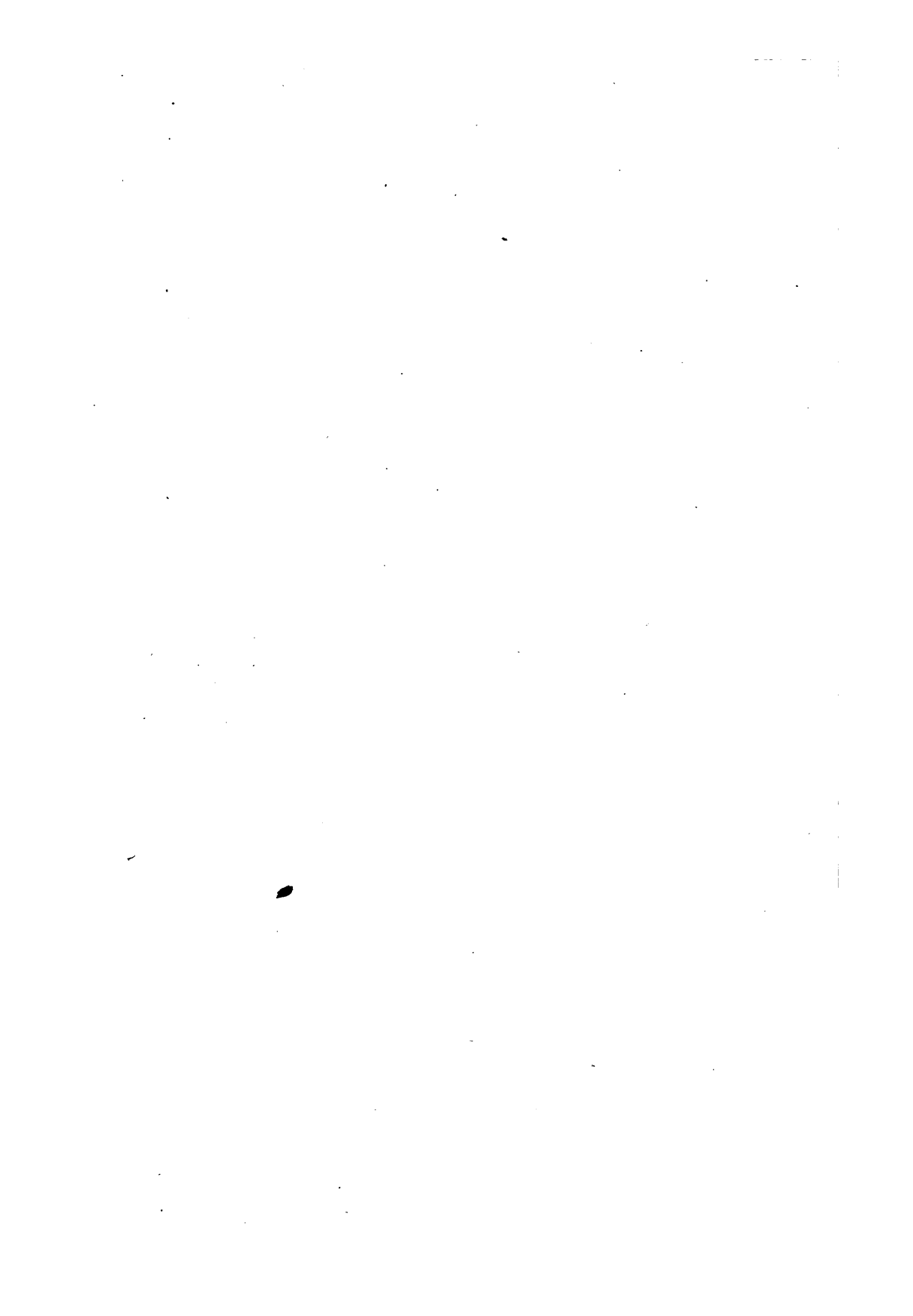
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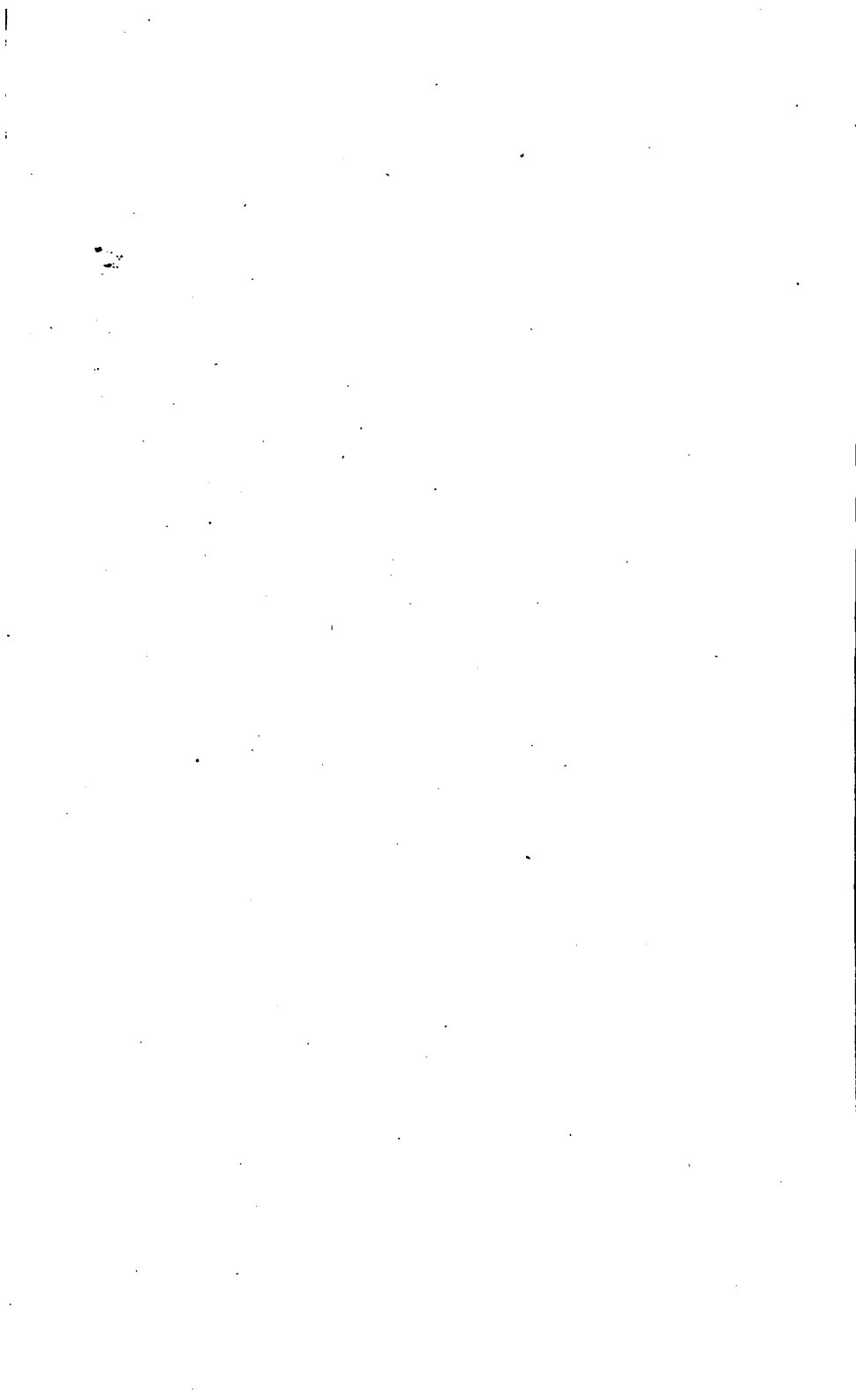
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Grant, C. W.

# INDIAN IRRIGATION.

BEING A

SHORT DESCRIPTION

OF THE

SYSTEM OF ARTIFICIAL IRRIGATION AND  
CANAL NAVIGATION IN INDIA.

WITH A

PROPOSAL FOR CARRYING THE SAME INTO EFFECT BY PRIVATE ENTERPRISE.

BY

*Charles William*

LIEUT.-COLONEL C. W. GRANT,

LATE OF THE BOMBAY ENGINEERS.

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"The Earth is of the Earth, Earthy; but Water comes from Heaven."

"As is the Water, so is the Country."—*Indian Proverb.*

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LONDON:

SMITH, ELDER, & CO., 65, CORNHILL.

BOMBAY: SMITH, TAYLOR, & CO.

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1854.

[Price One Shilling.]

40.37.50  
Eng 1045.54

1860, Sept. 18  
Gift of Rev.  
Andrew P. Peabody,  
(Class of '25)

LONDON:  
PRINTED AT THE "HOME NEWS" PRESS,  
63, CORNHILL.

## INTRODUCTION.

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IN the following pages we have endeavoured to explain the nature of artificial irrigation in India, its great value to the natives of that country, to its own Government; and to the British Crown; and the profitable nature of its works, as an investment for money, drawn from the facts that such works of this description, as have been undertaken by the Indian Government on a large scale, have, during the last 14 years in the Madras Presidency, yielded a return of 70 per cent., and *are now* producing upwards of 100 per cent. on the money expended in their construction; whilst in the North-west Provinces of Bengal, they have yielded, and are yielding, 26 per cent. on the capital. With such facts before them, a committee of gentlemen, all of whom are, or have lately been, connected with India, have proposed to establish a company for the purpose of extending artificial irrigation in India, proposing to begin their operations in the Province of Scinde—a country offering many advantages for the commencement of such an undertaking—as possessing a rich soil, dependant, owing to the scarcity of local rain, almost entirely upon artificial irrigation for its cultivation, but containing an abundant supply of water for feeding a canal from the river Indus, which intersects its entire length; from the favourable nature of the country through which the canal would pass for such an operation, and from the extreme facilities for conveying such produce as is suited for exportation to England, by the direct communication by large vessels now established with the port of Kurrachee.

But, as notwithstanding that the profits on all similar works hitherto constructed in India have been so great—from 20 to 100 per cent. on the capital invested—as to preclude almost the possibility of their failing



as a profitable investment for money, so much distrust still prevails on this point among English capitalists, where India, and India only is concerned, that it is proposed to apply to the Indian Government to grant a guaranteed dividend of 5 per cent. on the capital invested, in a similar manner to that granted to the Indian Railway Companies; and as soon as this request is complied with, a company for establishing artificial irrigation and canal navigation in India will be organised, and measures taken to secure an immediate commencement of operations.

LONDON, MAY, 1854.

## INDIAN IRRIGATION.

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ALTHOUGH Indian railways are still in their infancy, and on one line only has regular traffic commenced, still one of the greatest benefits that have been anticipated from them has already been produced; namely, the turning the attention of the British public to our Indian possessions. All that India requires, is the infusion of Anglo-Saxon energy, not for the mere purposes of conquest, but for the far higher object of ameliorating her condition, improving her resources, and demonstrating her vast capabilities as a producing country; and, as such, supplying the mechanical power of England with that raw material, without which her wonderful appliances and command of indirect labour would be valueless. The investment of English capital in Indian railways, has had the effect of turning the attention of those to whom we must chiefly look for the eventual amelioration of India to that country; and to those who know it well, there can be no doubt of the result: the stream of investigation has since set in in the right direction, and what we have now to do is, to see that it does not run fruitlessly along, but that it bears with it such an amount of knowledge and information as shall lead to a right application of our energy and the true development of the resources of our Eastern Empire. It is with a view of aiding this object that the following pages are written. Various books, pamphlets, and reports, bearing on the subject, have, it is true, appeared within the last few years; but the collation of the information they contain into a form accessible to the general reader, appears still to be a desideratum, which it is the writer's object to endeavour to supply, and, in so doing, to give no facts, to make use of no data, and to draw no conclusions that cannot be borne out by unimpeachable authority; and as such, entitled, it is hoped, to the confidence of the reader.

On the eve of a war with a country from whence a large portion of

the raw material necessary for our commercial prosperity has been supplied, it becomes us, instead of looking with concern or despair to the sudden stoppage of so important a branch of trade, to look about us, and that without any loss of time, to see whence, and by what means, the gap in our imports can be best filled up; and we feel sure that in no direction could our attention be better turned than to our Indian Empire—a country possessing every requisite for all natural productions. In the important article of fibrous substances, and the necessity of looking for a substitute for Russian hemp, we have the authority of Dr. Royle, who, in his interesting and valuable Lecture before the Society of Arts, said, “India is a country of such vast extent, so diversified in soil and climate, that we may readily believe it capable of producing every kind of natural produce, and amongst these almost every kind of fibre that is known elsewhere.” Some of these fibrous substances are suitable for the construction of rope, specimens of 4½-inch rope having been made from them, *superior in strength* to the best hempen ropes; others are applicable for the manufacture of coarse and fine cloths, and of paper, and of every article to which fibrous material is applied. Again, in another most important branch of our national manufacture—the cotton trade—India offers an inexhaustible source of supply, if only properly attended to, as well as in the articles of sugar, rice, and many others that it is needless here to mention. Enough has been said to show that, were we dependant upon India alone for our imports, there are few, if any, of the main articles on which our commercial prosperity depends, that could not be obtained from that brightest jewel in the British crown.

India possesses all the requisites for an unlimited production of all the fruits of Nature—a rich soil, abundance of moisture, an unlimited amount of heat, and cheap labour; and of these necessities to successful cultivation, one item alone requires any care or attention, but that is a most important one, namely—“moisture.” There is no want of moisture in India; there cannot be, where the average fall of rain is much greater than in our own island;\* but it has this

\* PRINCIPAL FALLS OF RAIN IN INDIA.

EASTERN INDIA AND BAY OF BENGAL.		SHORES OF WESTERN INDIA.	
	Fall of Rain.	Height.	Fall of Rain.
Cheerapoonj .....	610 inch.	Mahabaleshwar .....	4500 ... 248 inch.
Sylhet .....	209 ”	Altagherry .....	2200 ... 170 ”
Tavoy .....	208 ”	Kandalla .....	1740 ... 168 ”
Maulmain .....	189 ”	Untraymallay ...	6000 ... 164 ”
Sandoway .....	178 ”	Dapoollee .....	1200 ... 138 ”
Akyah .....	155 ”	Angara Kandy ... Malabar Coast	124 ”
Darjeeling .....	125 ”	Cannanore .....	Ditto ... 121 ”

peculiarity, that instead of falling nearly throughout the year, as in our own climate, it is supplied in great abundance within a limited period, leaving the remainder of the year unrefreshed by its presence.

The palpable course of dealing with such a state of things appears so obvious, that we can scarcely conceive that it has not been acted upon from time immemorial, or, at all events, from the time when we first obtained possession of the country. Where men are in the receipt of daily payments, they need take no thought of their accounts; each day's receipt is expended in providing for that day's subsistence; but where a person receives his whole pay or subsistence for an entire year at one payment, it behoves him to attend to its disbursement: were he to spend it all at once, and run riot in the excess of his wealth, he would soon come to the bottom of his purse, and find himself starving before one-third of the year for which his payment was to last had passed; but if prudent, he will take such measures for hoarding or securing his supplies as shall ensure their lasting him throughout the year.

AVERAGE FALL OF RAIN AT BOMBAY FOR 30, AND CALCUTTA AND MADRAS FOR 8 YEARS, NEAR THE LEVEL OF THE SEA.

	Madras.	Bombay.	Calcutta.
January .....	3.50	.0	0.71
February .....	2.00	.0	0.55
March.....	0.25	.0	1.10
April .....	0.23	.0	2.95
May .....	5.00	.0	4.59
June .....	1.80	22.13	12.74
July .....	2.80	24.88	13.15
August .....	3.30	16.77	16.82
September .....	5.50	11.05	7.83
October .....	9.40	1.25	4.83
November .....	10.30	0	.82
December .....	8.20	.0†	.50
Total .....	62.27	76.08	66.59

REMARKABLE FALLS OF RAIN IN INDIA AND OTHER PARTS OF THE WORLD.—At Geneva, 25th October, 1822, 32 inches fell in 24 hours; at Flangurques, 6th September, 1801, 14 inches fell in 18 hours; on the 20th May, 1827, 6 inches fell at Geneva in 3 hours; at Perth, on the 3rd August, 1829, four-fifths of an inch fell in half an hour; on the 22nd November, 1826, nine-tenths of an inch fell at Naples in 37 minutes. In India, at Mahabaleshwar, in 1834, 302 inches fell in 100 days; on the 4th of October, 1846, 10 inches fell at Chittledrooj in 24 hours; at Bombay, in 1844, 7½ inches fell in 24 hours; 2 inches fell in 70 minutes on the 1st, 2.43 inches on the 10th, and 12 inches on the 26th July, 1849, at Bombay. At Rajkote, on the 26th and 27th July, 1850, 26 inches fell in 24 hours, and 35 inches in 36 hours; 7 inches fell in 1 hour and a half at Ahmedabad; 13.5 inches fell in 24 hours on the 23rd and 24th July. At Cheerapoon, 227 inches fell in June, 1841—600 being about the average for the season; in August, 150 inches fell in 5 days (being the largest fall on record), and 264 inches within the month.—*Buist on the Physical Geography of India. Edinburgh Philosophical Journal*, April, 1854.

† Occasional showers occur at Bombay sometimes all the year round, of which no account has been published in the Register. The majority of years are rainless from October to June.

So it is with the rain in India; it falls during four months of the year in such quantities as to be ample for all purposes to which it can be supplied; but if neglected or allowed to run to waste when in such abundance, the spendthrift's career is soon made apparent, and famine and starvation stare in the face those who, by a little prudence and forethought, might have been revelling in comfort and abundance. It is estimated that in the famine of 1837 in India, the Eastern and Western Jumna Canals alone saved upwards of two millions of money to the state, besides many thousand human lives; whilst in the district of Guntoor, where no such precautions had been taken, in one year a famine occurred and swept away *one-half* of the population.\*

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\* We have famines which occur decennially, some of which within our time have swept three millions away. In 1833, 50,000 persons perished in the month of September, in Lucknow; at Cawnpore, 1200 died of want (though £500,000 was subscribed by the bountiful to relieve the destitute). In Guntoor, 150,000 human beings, 74,000 bullocks, 159,000 milch cattle, and 300,900 sheep and goats died of starvation. Fifty thousand people perished at Marwar; and in North-west Provinces, 500,000 human lives are supposed to have been lost. The living preyed upon the dead; mothers devoured their children, and the human imagination could scarcely picture the scenes of horror that pervaded the land. In twenty months' time 1,500,000 persons must have died of hunger, or of its immediate consequences. The direct pecuniary loss occasioned to Government, by this single visitation, exceeded £5,000,000 sterling—a sum which would have gone far to avert the calamity from which it arose, had it been expended in constructing thoroughfares to connect the interior with the sea-coast; or districts where scarcity prevails, with those where human food was to be had in abundance; or on canals to bear forth to the soil, thirsty and barren for want of moisture, the unbounded supplies which our rivers carry to the ocean. Mr. Montgomery Martin describes famines of fearful magnitude as having occurred in 1640, 1655, 1661, 1764, 1766, 1770, 1782, 1792, 1803, 1804, 1819, 1820, 1824, 1832, 1836, 1837, and 1838—or eighteen in two hundred years.—*Dr. Buist on India. Major Cotton's Report in the Journal of the Madras Literary Society, 1843. Asiatic Journal, vols. xxvii—xxxvii.*

The famines in India bear no relation in the eradicability of their source or difficulty of their cure to those we are in the habit of witnessing or of endeavouring to alleviate in our own land. Where a disease in the principal element of human food, or an inauspicious season falling on a poor and overpeopled-country, reduces the inhabitants at once to a state of absolute starvation, on the verge of which they have always been hovering, calamities such as these cannot be foreseen by any amount of forethought, or provided against by any effort of philanthropy; and even the relief obtained by emigration when famine has done its worst, is but temporary, the tendency being for the human animal to multiply again so soon as the immediate pressure from without is withdrawn, up to the limit of sustenance in the average of seasons, to be thinned out again by death when seasons fall behind their average. In India we have but one source of famine—want of rain; and Providence, as if to excite the intellect and stimulate the industry of man, in this, as in 10,000 of other cases, has put the remedy within our reach, if we will only stretch forth our hand to grasp it. In India we have two stupendous river systems—the Himalayan and Hindostanee—drawing their supplies from totally separate sources, and traversing or surrounding the whole of the districts subject to the visitation of famine. The Indus, with its five magnificent tributaries which intersect the Punjab, and the Ganges and Burrampootra, with their gigantic branches, derive their principal supplies from the melting of the snows; and the more fiercely the sun shines on the hills, and the more insufferable that are the heats below, the more penitently do these gelid storehouses give up their treasures. The whole of the Hindostanee system of rivers, again, consisting of the Sabermutti, the Mhye, the Nerbudda, the Taptee, all discharging themselves into the Gulf of Cambay in Western India; the Godavery, the Kistna, and the Cauvery, falling into the Bay of Bengal—all originate in the western mountains, and are fed by the rains which fall over these on an average to the extent of 100 inches during the months of June, July, and August. Both systems, whether fed by snow or rain, are in flood at the same period of the year, that

To this point then we now desire to draw the reader's attention, namely, to the means by which that abundant but temporary supply of water in India can be turned to the best account; and it is scarcely necessary in so doing, to refer to the system of artificial irrigation as that by which this object can alone be accomplished.

There are four ways in which artificial irrigation in India is effected—1st, by wells; 2nd, by storing up water in tanks or large reservoirs; 3rd, by constructing dams across rivers, and thus leading the obstructed water into irrigating channels; and 4th, by means of large canals fed by rivers, and acting themselves as feeders to smaller channels. Of these, the two last methods are by far the most efficient as being on the largest scale, and affording the most plentiful and certain supply of water; for in dry seasons or where the *local* rains have been scarce, wells and tanks will fail; but as our principal rivers in India are not wholly dependant upon the local rains in the districts through which they run, but either upon the melting of the snows on the huge Himalayan range, as in the cases of the Ganges and Indus, or upon the heavy rains on the mountainous districts in which they take their source, as in the case of the Kistna and Godavery, which depend in a great measure for their supply from the rain which falls on the Western Ghauts or Syhadree range, they may, by retaining their waters, be made to provide an abundant supply of moisture to countries through which they pass, but where little or no local rain may have fallen.

Indeed, by taking proper advantage of this bountiful provision of nature, districts may be made almost entirely independent of local rains, as is the case in Scinde, or in a parallel description of country, Egypt. As the mountain would not go to Mahomed, Mahomed went to the mountain; and so in this case, if the rain will not fall at our doors, we must go and seek it, or rather, in this instance we have not

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being just the season when moisture is most required. Both draw their supplies from mountains too rocky or barren to require moisture, and too steep to retain it, and which send to the ocean, through tracts of the finest country in the world, supplies of water sufficient to transform them into one universal garden, would man only bestir himself and perform the task prescribed to him. Of late years science has shown a fearful amount of mortality produced in this country by want of cleanliness, and philanthropy has set vigorously about the removal or mitigation of the maladies, the existence or sources of which seemed scarcely before suspected. In this noble work there are stupendous obstructions to be surmounted, formidable not only from the expense and labour required to surmount them, but from the extreme difficulty of discovering how the means provided for their removal may be best applied to secure a remedy. In India it is in all respects the opposite of this. There, benevolence meets with no obstacles in the way, but those of its own creation, and the profits its exercise secures are so incredible that the wonder is that we should so long have neglected it, when good works brought along with them so immediately their own reward.—*Dr. Buist on India*

even to seek it, but make use of what is actually passing our very threshold, and calling out to us in its bubbling ripples to detain and apply it to our own purposes and advantages.

And of the two methods by which the waters of a large river can be best turned to account, that of leading its superfluous stream through a country by means of large canals is probably the most efficient, and has consequently been the most adopted.

This system of artificial irrigation in India is no new idea; it was carried out on a large scale by our predecessors in conquest, the Mahomedan conquerors of India, the remains of whose works of irrigation, now scattered throughout India, bear testimony both to the importance which they attached to this simple and direct method of improving the country, as well as to the energy and spirit with which they carried it into execution. The Eastern and Western Jumna Canals, already alluded to as having been of such important service during the famine of 1837, were both originally excavated by the Mahomedan rulers of the country—one of them in the fourteenth century—and which, having been repaired by our Government about 30 years ago, are still demonstrating the forethought and wisdom of those, on whom we are apt to look as less civilised and enlightened than ourselves.\*

The Eastern Jumna Canal, says Captain Baird Smith, of the Bengal Engineers, flows about 145 miles; its subordinate channels, each a small canal in itself, with its complement of masonry works, exceed, at this time (1849), 490 miles in length, and are extending annually. It

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\* The Emperor Feroze constructed, about the year 1350, a magnificent canal, for the purposes of irrigation, from the base of the mountains to the neighbourhood of Delhi, 200 miles in length, by means of which a vast track of country was made fertile as a garden, and above a million of people provided with bread. Two centuries after this, the illustrious Akbar devoted himself to the construction of new canals for the purposes of irrigation, and the clearing out of those formed by his predecessors, and which had fallen into decay. He made the subject a regular part of the system of government, and left a canal act behind him, which has come down to our times, providing for a complete series of arrangements and a large array of officers for their extension and management. The Shah Jehan, 70 years later, took up with enthusiasm the plans of his predecessors, and was nobly seconded in his efforts by Ali Murdan Khan, celebrated over the east for his skill and taste in architecture. The success of their labours was magnificent; tradition still enlarges on the vastness of the returns derived from the canals brought into existence by them, which were such, as for a single canal to pay for the maintenance of 12,000 horsemen. The permanent establishment maintained for police purposes, consisted of 500 horsemen, and 1000 footmen, armed. It is mentioned by Ferishta, that during the earlier of these excavations, vast collections of giants' bones were discovered, and in our time the extension of the canal system in the same quarter has disclosed in these the skeletons of numberless extinct animals; the Mammoth and Mastodon, the Bramatherium, and Sevatherium, and the other kindred contributions Colvin, Lurand, Cautley, and Falconer, have made to our Indian paleontology. Our first canal operations commenced little more than 30 years ago, and in 1831, the waters which had five centuries ago been made to visit the city of Delhi, were, after 50 years' suspension, re-introduced into their former channels.—*Dr. Buist on India.*

supplies 600 villages, covering 497 square miles of area, and containing a population of 300,000 souls.

The Western Jumna Canal is nearly *four* times as large as that on the eastern bank of the river, and has a course of about 430 miles in length. It has enabled Government to derive from the tract of country under its influence a land revenue of £29,000 per annum, in excess of what would otherwise have been obtained. The total area of irrigated land amounts to 4025 square miles, and the land revenue derived from the canal districts is nearly £100,000 per annum, *and is placed beyond all risk of fluctuation*; and during the great famine of 1837, when the crops failed everywhere else from want of water, the canal districts were safe and flourishing.

Various minor canals have been executed in the North-West Provinces of Bengal, and many similar ones are now in progress in the Punjab; but the most extensive of all operations of this kind is undoubtedly the Great Ganges Canal, which will extend the resources both of irrigation and navigation through a length of 900 miles of country, watering an area of upwards of 5,000,000 of acres, and relieving a population of 6,000,000 of the fear of those famines which have so often rendered whole provinces in India entirely waste and desolate.

If we turn to Southern India, we find that in the Madras Presidency considerable works of irrigation have been executed, but of a somewhat different description. Instead of excavating large canals, as in the Upper Provinces of Hindostan and in the Punjab, the system followed in the south has been to erect weirs or dams across large rivers, and then to divert the accumulating water into irrigating channels intersecting the country.

By means of a weir thrown across the river Godavery, 1,200,000 acres of land will be irrigated and drained, and almost 1000 miles of the river made available for navigation; while from similar works on the rivers in Tanjore, the revenue is increased from £300,000 to £500,000 a-year, the population is doubled, and the value of the land equally increased. In the Presidency of Bombay, but very little has been effected in this way, and that on a very small scale, chiefly consisting of the repairs of existing waterworks, although there are many large tracts admirably adapted for the full development of the system. In Scinde, where there is no regular periodical fall of rain, cultivation beyond the limits of the inundation is entirely dependant upon artificial irrigation, which has been long in use in the province, chiefly by means of small canals from the Indus, but which are neither in extent



or character at all in keeping with the agricultural capabilities of that country.\*

"In irrigation," says Colonel Cotton (a very high authority on such matters), "water may be used in three ways."

"1st. For the complete irrigation of a crop which requires to be constantly and abundantly supplied beyond what the ordinary measures afford.

"2nd. To enable us to grow, at those seasons when no rain at all can be expected, things that require merely a trifling quantity of water.

"3rd. As in the case of sugar, to enable us to grow what requires so long a time to nurture, that the monsoon is not of sufficient duration."

Thus almost, if not every description of agricultural produce can be improved by irrigation, and many crops, such as rice and sugar-cane, are entirely dependant on it; so that water may truly be called the very "life blood" of India.

Captain Baird Smith says "that the average quantity per acre in irrigated lands is, according to revenue survey statistics, about 600 lbs. in excess of land not irrigated, for the rubbee or cold weather crops of wheat, barley, &c. ; while the valuable rain or Khurreef crops, as sugar, cotton, &c., cannot be reared at all without irrigation." For cotton, the great staple of our home manufacture, irrigation has been long practised with success in all countries where it is grown, except in India, where it has been only applied experimentally, but always with success. Two of the chief points insisted upon for the successful cultivation of cotton are watering and drainage. "In Syria," says Dr. Ure, "the cotton plant is treated in the same manner as the vine, and it yields every year a good crop by means of ploughing and irrigation." In Abyssinia, the cotton plant varies according to the locality and supply of water, from 3 feet in height to upwards of 7 feet. In Egypt, it is entirely grown by irrigation; and in some experiments tried by Captain Lawford, of the Madras Engineers, the produce was matured under watering in half the time, and was 500 per cent. greater.

Having thus briefly alluded to the advantages derivable from artificial irrigation in India, it naturally occurs next to show the profitable nature of the means hitherto adopted for this purpose, and fortunately it will not be difficult to do this, from the most authentic sources, and from the best of all arguments—that of actual experience; and it must be here premised, that however fabulous some of these statements may

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\* Scinde is often three or four years without any rain whatever; when it comes it destroys the houses which are nearly all of mud or unburnt bricks, and brings disease along with it, and is anything but welcome.—*Burnes—Postans—Thornton, &c.*

appear in a country where we are all craving after a return of 4 and 5 per cent. on our money, and think ourselves very fortunate if we can obtain it, that they are nevertheless undoubted facts and cannot be controverted.

From the Madras government returns it appears that the State has derived a return of 70 per cent on works of irrigation executed during the last 14 years, some of which are scarcely finished, whilst others are far from realising the full return they are capable of yielding, so that the *present* return on the money there is considered as upwards of 100 per cent., in some instances the profits have been 140 per cent., never less than 30 per cent., and the Government will not entertain any scheme which does not on the estimate of their own engineers promise a return of 15 per cent. The Western Jumna Canal now returns by direct and indirect revenue about 38 per cent. on the amount of capital required for its construction. The Eastern Jumna Canal pays 24 per cent. on its capital, whilst the Great Ganges Canal is expected to produce an income of £160,000 from the sale of water, and an increase of land revenue of no less than £240,000 or £400,000 per annum in all, on an expenditure of 1½ million of money.

With these facts before us, it will scarcely be wondered at, that a committee of gentlemen should have associated themselves for the purpose of endeavouring to obtain artificial irrigation for India on a large scale; and as a report of the meeting held for this purpose on the 29th of April last, is appended to these remarks, it has rendered it unnecessary to enter in this place more fully into the details, and merits, and advantages, of establishing a system of canal irrigation in India—a scheme that not only offers every inducement on the score of personal advantage, and as a most promising investment for money, but one that every man interested in the welfare of India, and indeed in our own national prosperity, must hail with satisfaction, as affording the best means that have yet been devised, for ingrafting British energy and capital on the vast capabilities of India as a producing country, thus mutually benefiting both lands, and drawing closer those ties of union which ought to subsist between them, and to the advantages of which we are but just now beginning to open our eyes.

During the last two or three years a complete exodus has been in progress from the British Isles in search of gold in far distant countries; no sooner was it announced that the precious metal had been discovered in Australia, than eager crowds rushed to the shipping ports, selling all that they possessed to obtain the means of conveyance to the El Dorados. But after all, gold is but a conventional medium for obtaining

the necessaries and comforts of life; it is a mere article of barter, which, from its scarceness, hitherto has permitted of a small bulk of it being equal in value to a large amount of other articles. But if an equivalent could be found for gold—if anything could be discovered that existed in greater abundance and was more easily obtainable than the precious yellow metal, and of which a certain quantity could be procured at a less cost of labour to its equivalent in gold as a medium of barter—then surely it must be more advantageous to a community to employ themselves in amassing that article, be it what it may, than in digging for gold. In water in India we have that article, more abundant, more valuable, and more easily obtained than gold. Do the *average* of the gold diggings of California or Australia yield a return of from 70 to 100 per cent. on the labour expended in procuring the metal? Great fortunes may occasionally be made by fortunate individuals, but as an *average return* for labour expended, the proceeds of the gold diggings will fall very far short of the profits of the water seller in India.

The river Indus, in Scinde, discharges in December, or when at its lowest, upwards of 40,000 cubic feet of water per second, or at the rate of nearly 50,000 million cubic yards a-year; of which, if we suppose 3000 million cubic yards only abstracted for the purposes of irrigation, they would be equivalent in value to 150,000 ounces of gold, assuming water to be worth 1 rupee or 2s for 500 cubic yards, the price at which it is sold for irrigation all over India, and which could be obtained at from 2s to 6s an ounce, according as the rate for storing water is taken from its actual cost in the Ganges or Jumna Canals, or Madras works.

This is taking the supply of water in the Indus at its *lowest*, and then only one-seventeenth of its actual discharge; but if its *average* discharge throughout the year were taken, the result would be incomparably greater, and this is only one of numerous rivers all running with similar wealth. Now, what would be the effect of its being known in England that there were numerous rivers in India whose streams yielded gold at the rate of 150,000 ounces a-year, and that this gold could be collected at a cost of labour of from 2s to 6s an ounce? Why we should have half the population of the country rushing to these inexhaustible mines of wealth.

But this is nevertheless the case;—if 20,000 cubic yards of water will fetch in the market 40 rupees, or £4, the same that an ounce of gold will fetch, it must be equivalent in value to that ounce of gold; and that millions and millions of cubic yards of water can be obtained in

India at rates varying from 2s to 6s for a quantity that will meet with immediate sale at 80s or £4, there can be no shadow of doubt; the records of the Indian government prove it, so does their exchequer, and it therefore can admit of no question.

Can it be supposed then, that where a whole community are searching about for a good investment for their money, are studying the share lists, are calculating whether this or that investment will pay them 4 or 5 per cent., that they would hesitate one moment to take advantage of a scheme which offered them at least 15 or 20 per cent. on their capital invested in it? Certainly not. If the public were really and truly to believe that the statements put forward in the Prospectus for Canal Irrigation in India were *unquestionably true*, there would be such a rush made for shares, that the difficulty would be, not to fill up the share list on the day it was issued, but to limit the amount to which it should be extended; and yet we have only to refer to published documents, to undoubted facts, and to the personal experience of those who have been engaged in the matter to verify our assertions. When railways were first proposed for India, what inducements were the projectors able to hold out to the public to entice them to join their scheme and invest their money in the venture? The results of railways in England. What were they? In many instances no returns at all, the money expended, clean gone; in some 2, in others 3, per cent.; in how many as much as 5 per cent. on the capital invested? And yet the share lists were filled up!

But what is the difference in our case? Instead of referring to similar works in England as our only guide, and which works have rarely made any good return for the money sunk in their execution, we can boldly and fearlessly point to precisely similar works in India, the field of our proposed labours, and show that when these works have been carried out in India, they *have* returned from 24 to 70 per cent. on the capital invested, and are now at this present time, many of them yielding upwards of 100 per cent., thus returning the money expended upon them in one year. Throughout India, where works of irrigation have been constructed, thousands and thousands of people have been found willing and anxious to purchase the water there provided for the irrigation of their crops, at the rate of 500 cubic yards per rupee, or for 2s. And to show that what has been done, may be done again, we have only to compare the quantity of land now under artificial irrigation, with that capable of being so treated—were the means provided for so doing—to assure us of the vastness of the field thus laid open to us, and to the capability of employing an almost unlimited

amount of capital in this manner, with a certainty of an equally favourable result.

Enough, it is believed, has been said to show the profitable nature of works of irrigation in India, and the vast field that is open for their extension; indeed, if what has been now advanced is not sufficient to convince any one of the undoubted advantages of the undertaking we propose to engage in, it would be but lost time to bring more arguments to our aid. But as the Government of India are the possessors of nearly the whole of the land in India, and as it is proposed to sell water to the natives of India for the cultivation of their land, it is clear that the Indian Government are a most interested party in the matter; in fact, the undertaking could not be carried on without their cordial concurrence and support; but we can see no reason why such concurrence and support should be withheld, for whatever tends to increase the prosperity of a country must be beneficial to the rulers of that country; and that works of irrigation have, and are increasing the prosperity of India, we have abundant proof.

Captain Baird Smith tells us that the Eastern Jumna Canal, in addition to its direct income from the sale of water, yields in indirect returns, from the increase of land revenue, at least £25,000 annually, and that, from the Western Jumna Canal, the Government have derived a land revenue of £27,000 per annum, *in excess* of what otherwise would have been obtained; whilst the Great Ganges Canal is expected to cause an *increase* of land revenue of no less than £240,000 per annum. In Tanjore, the revenue has risen £200,000 per annum since the great irrigating works in that province were constructed, whilst the increase in the value of its lands since 1836 amounts to one and a half million sterling, and the increase of land revenue that the Government will derive from the extensive works just on the eve of completion in the Godavery is equally assuring. Government, therefore, are incontestibly great gainers, even in a pecuniary point of view, from the construction of works of irrigation in the country subject to their control, independent of the profit they derive as sellers of water; but when to this is added the saving of millions of lives—(250,000 people perished in Guntoor alone in one year)—and the actual *loss* to Government of such a famine amounting, according to Colonel Cotton, to £800,000 in the 10 or 12 years following, and the many indirect channels through which the prosperity of a community flow into the Government coffers, we cannot for a moment doubt that the Indian Government must be most anxious for the extension of works of irrigation in India. The only point then that

remains for consideration is, in how far the Indian Government may be expected to support private enterprise in carrying such measures into execution; and here, without entering into the often-discussed question as to the advantages of all such undertakings being left to private enterprise, we may simply advert to the fact that the Government of India have admitted the principle, in sanctioning and supporting the establishment of railway companies in their dominions, which they might have carried out themselves, had they desired to do so, or had it been considered to the advantage of the State that the railways in India should have been constructed by the Government.

The principle of permitting private enterprise to carry out large and important works in their country has been admitted in the case of railroads. We can see no reason why we should doubt a similar concession being made to a company for constructing canals of irrigation, and, if necessary, of navigation in India. The internal communications of a country are as important an item of political economy as the agricultural resources of that country, for without the means of transit, or of conveying the produce to the consumer, the produce itself becomes valueless, and therefore it cannot be considered that, in seeking to establish a company for the purpose of constructing canals in India, we should be in any way interfering with the peculiar province of the Government, more than has been done by the introduction of joint-stock railway companies; and we therefore look with confidence to the liberal support of the British Government in India to our undertaking.

When the idea of constructing railways in India was first broached, it was found necessary, so little understood was the country or its resources, to apply to the Indian Government to grant a guarantee of a specified dividend on all the capital proposed to be embarked in the undertaking, as the only means of overcoming the scruples of English capitalists, and of inducing them to invest their money in the enterprise. So in the present case, although instead of being able solely to point to the unpromising results of English railways, as data on which to found a prospect of success in establishing railways in India, we are enabled confidently to appeal to *actual returns of from 24 to 100 per cent. on invested capital*, on works precisely similar to those which we propose to construct, we feel, that however bold and often incautious British capitalists are in taking up any scheme, or in investing their money in any undertaking, in any country except India, that when India is the intended scene of operation, however really and incontestibly advantageous the proposed operations may be,

that all their boldness and spirit of adventure seems to desert them ; they draw back into their shells, shut their purse-strings, which nothing but the tempting bait of a guaranteed dividend will induce them to come out of, or open them.

On these grounds, then, and on these grounds only, being desirous of securing the English capitalist in our undertaking, we propose applying to the Indian Government to grant a guarantee of 5 per cent. dividend on all the capital subscribed on similar conditions to those allowed to the first railways. It was said by a late member of the Indian Government, at the meeting held on the 29th of April, that Government never entertained any proposal for any work of irrigation, on which a certain dividend of 15 per cent. could not be shown to be secured ; and as our Company might well bind itself not to undertake any work that would not, on the showing of their own engineer officers, yield a return of, say at least 7 per cent., the guaranteed dividend would, it is confidently believed, become a mere form, and be more than repaid the moment the works came into operation.

Having now, it is hoped, sufficiently explained to the reader, the objects and advantages of the proposed undertaking of a Canal Irrigation Company in India, we shall proceed to give some idea of the manner in which it is proposed to carry this project into effect, premising, however, that as the exact line a canal must take, its details of construction and precise estimated cost, can only evidently be determined after careful surveys and examination of the districts in which it is proposed to carry on the works, we shall confine ourselves more to general than to specific data, taking care, however, that these data shall be founded on such results of actual experience and execution, as shall not admit of a doubt being entertained of their accuracy.

Perhaps there is scarcely a single province or district in India in which large works of irrigation could not be introduced with advantage to the inhabitants and profit to the projectors. Taking the Western Presidency alone, there are the Kistna and Godavery rivers, taking their rise in the Syhadree range of Ghauts, and then running through extensive plains of beautiful soil, formed chiefly of the disintegration of the Basaltic rocks, and requiring only water to make them as fruitful as any part of India. Then there is the Province of Candeish, a perfect garden, which is now partially benefited by numerous small works of irrigation, the irrigated portion bearing ample testimony to what the whole province might become were irrigation extended over it in a large and comprehensive manner. Further north, we have the

valleys of the Taptee and Narbudda, with their Deltas, the very heart of our cotton cultivation, where that shrub was originally introduced into India, and where it has, from that time to the present, produced fibre of superior quality to that grown in any other part of our dominions; for a confirmation of which, we have only to examine the monthly reports of the Bombay market, in which the superiority of the Gujrat cotton will be seen exemplified by the best of standards, that of the relative price it fetches in the market.\*

Advancing still further north, there are the valleys of the Mhye and Saburmuttee, with their Deltas, forming the northern boundary of the Gulf of Cambay, and flowing through a light but most productive soil, when properly supplied with moisture.

The Province of Kattiaaur, although not immediately belonging to the British Government, offers a fine field for works of irrigation; it contains most extensive plains of very rich soil, intersected with particularly fine rivers, which retain a depth of water throughout the year, quite unusual in the rivers in the adjoining districts, and containing every element for becoming one of the richest and most productive districts in India.

If we then proceed to Cutch, we find a country crying for water, the uncertain nature of the periodical rains causing an average of three or four years of drought, to one of a productive crop; here is a tract of land, bordering the Gulf of Cutch and Indian ocean, nearly 200 miles in length, and about 10 in breadth, or containing an area of nearly 2000 square miles, consisting of the richest alluvial soil, on which grain grows in great abundance in favourable seasons, but where far too frequently miserable stunted crops are seen, owing to the scarcity of water.

On the north and west side of this province (Cutch) lies the Runn, now an arid desert, but once partly an inland sea, and partly, namely at the northern extremity near the town of Luckput, a vast plain of rice cultivation, periodically watered by a small branch of the river Indus, but now a salt waste, owing to the waters of the Indus having been shut off from it; partly by the Scindians, when at war with the rulers of Cutch; and partly by the great earthquake of 1819, which

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\* The best kinds of this extraordinary soil (Regur or black cotton clay) are rarely suffered to lie fallow, except by accident, and never receive manure, which is even supposed to lessen its fertility. It has yielded annually, crop after crop, for upwards of 2000 years (usually in triennial rotation), of cotton, juari, and wheat, or bajri, without receiving any aid from the hand of man, except an annual scratching with a small plough, and a decennial, or still more seldom, clearing of the nuth-grass by means of the large plough. It is irrigated solely by the dews and rains of Heaven.—*Newbold's Summary of the Geology of Southern India. Journal of the Royal Asiatic Society*, vol. viii., p. 264.



elevated a natural bund or dam across the branch of the river which supplied the rice tract, effectually stopping the progress of the stream, since which time that once fruitful and productive tract has not yielded one rupee of revenue to the State.

Continuing our survey, we arrive at Scinde, sometimes called Young Egypt, and capable of becoming, there is little doubt, as rich and fertile a country as its antitype. Here we have a large district, where little or no regular rain falls—an average, we believe, of about 4 or 6 inches per annum, with intervals of many years when no rain falls at all—and the cultivation of which is entirely dependent upon artificial irrigation.

The province of Scinde, from Shikarpore or Sukkur on the Indus to the sea, a distance of between 300 and 400 miles, is directly intersected by the river Indus; the terms, right and left bank of the river, pretty nearly embracing the whole of the cultivated portions of the country. Here it may be supposed, as in Egypt, the river is the bank from which all their wealth is obtained, and a well-stored and productive treasury it is, if only rightly managed; but, as may be imagined, the works of the irrigation that supplies the cultivators with the means of subsistence, are not of the nature or description likely to turn the means at disposal to the best account. But with a rich soil, a hot sun, and plenty of water, there can be no doubt of the productiveness of the province, if only these three necessities for successful cultivation are turned to the best advantage.

Whilst, therefore, all the districts through which our cursory examination has extended, open a fine field for successful enterprise, and for works of irrigation, there is none, probably, to which a consolidated company could so well turn their attention as to Scinde, especially, in the first instance, for this reason—in all such operations as that in which we propose to embark, an unity of action is most desirable, as well as a concentration of our labours and resources. No doubt, on each of the points before referred to, works of irrigation might be carried out with success; but it is doubtful whether in any one district except Scinde, a *single* work could be found, offering employment for a large capital on so simple a line of operations, requiring, consequently, only a small staff of executives, and admitting of a development of the system on the largest scale with the smallest outlay. Were we to undertake several smaller works at once, such as would be sufficient for the employment of a large capital, they would be scattered here and there; would require several, instead of one head executive, and thus, by dividing the points of attention, would multiply the staff and superintendents, and greatly increase the expense.

And here it may be remarked, that the larger the capital with which a company work, the less the average cost of management—the same Board of Directors, the same executive staff, the same offices, the same correspondence will suffice for a large as for a small capital. It is the same as with the military force of a country; the same general staff and heads of command and department will regulate an army of 100,000 men as is required for an army of 50,000 men. Where the capital is contracted, the works are necessarily contracted, and their sphere of usefulness often so crippled as to defeat the original object in view. For instance, the irrigation and water transit of a certain country must require a canal suited to the geographical features of that country. *A canal cannot be made half-way.* It has been the ruin of railway schemes attempting to make them piecemeal; but it strikes at the very existence of a canal, the *head and tail* of which must be defined by physical conditions, and not by the length of the purse. With a large capital, then, we might be able to undertake a most promising and advantageous work, which a small invested amount would not admit of being undertaken at all. And it almost invariably occurs, that the original capital requires to be subsequently increased, whilst the works are prevented from being carried out on that comprehensive scale, and with that unity of design and purpose, that could have been effected, had the amount of capital been from the first equal to the undertaking proposed to be eventually put into execution.

Now, nothing can be simpler than the conditions afforded for the construction of a canal of irrigation and navigation intersecting the province of Scinde. Here, we have a large river containing an abundant supply of water, which does not depend upon the casual circumstance of a local fall of rain, but on the unfailing supply from the everlasting snows of the Himalayas, running in a slightly tortuous course through a rich alluvial soil, with a descent of about 100 feet in upwards of 200 miles, or sufficient to secure an abundant supply of water; the discharge of the Indus in the cold weather, or least favourable season; being upwards of 40,000 cubic feet a second; whilst, during the freshes, the quantity it gives passage to is nearly incalculable.

Here, therefore, every opportunity is offered of cutting a canal from some point near the head of the province of Sukkur, carrying it as a chord to the arc formed by the river in the direction of Hyderabad, and there seizing a favourable position for its again joining the river; whence, if funds were available, an irrigating branch might be continued to the river near Luckput; thus not only supplying a very large additional extent of country, but in all probability eventually restoring

to the inhabitants of Cutch, what the vindictiveness of their enemies has for so long a period deprived them of.

It has been calculated by those well acquainted with the country, that on the left bank or east side of the Indus, there are 1,000,000 of acres, or upwards of 1500 square miles of land susceptible of cultivation from irrigation, or an average breadth of 8 miles for a length of 200 miles. Captain Baird Smith reckons that the total area of a country being given, a deduction from this of one-third of its amount on account of ground lost to cultivation, as being occupied by sites of towns or villages, beds of rivers, jheets, or unculturable soils, furnishes a fair approximate estimate of the extent of land either actually cultivated, or culturable under favourable circumstances, so that the above estimate would only imply a total breadth of culturable ground of 12 miles on the eastern side of the Indus.

It is therefore proposed to commence operations in Scinde, with such a capital as shall enable the company at once to complete a canal of irrigation, and bring a line through the extent of country above indicated. It would of course be absolutely impossible to give the *exact* amount of capital required for such an undertaking, without a minute and detailed survey of the ground; but, fortunately, we have all the required data at our disposal, to enable us not only to form a very correct estimate of its *probable* cost, but also of the profits almost certain to accrue from carrying it into execution.

Captain Baird Smith says, that it is known from experience on canals in the provinces, that a discharge of one cubic foot of water per second is sufficient to water during the year 218 acres of land; but as irrigating villages are found only to water about one-third of their lands, the remaining two-thirds being either occupied with inferior crops, or allowed to lie fallow for the succeeding season, this increases the irrigating effects to 654 acres of culturable land; but wherever canal irrigation has been carried out, it is found to be accompanied from wells in those spots which, from the profile of the ground, the water from the canals will not reach; the general average proportion of the two methods being as 10 to 1: this, added to the former amount, will bring the area of culturable land, that a discharge of 1 foot per second would supply, to a little more than 700 acres.

Now it is stated that the Great Ganges Canal, with a discharge of 6750 cubic feet per second, will irrigate a tract of country having an area of 5,400,000 acres; to which, if the same rule is applied, it will give an area of 800 acres per 1 foot of discharge per second; thus showing that the canal would provide water for irrigating nearly the

*whole* of this vast area, instead of only two-thirds of it, as is generally allowed.

Colonel Cotton allows 500 cubic yards of water for one watering of 4 inches in depth, or 1000 yards per acre per annum for dry crops, and about 5000 cubic yards per annum for rice crops grown during the monsoon, and 7000 for those grown in the hot season; whilst a *sugar* crop requires no less than 15,000 cubic yards of water per acre during the 300 days that it requires to be irrigated. But a discharge of one cubic foot per second would supply about 5000 cubic yards of water an acre, supposing it to be sufficient for the actual watering of 218 acres, as stated by Captain Smith; so that, taking the average of sugar, rice, cotton, and dry crops into account, the results arrived at by these different means of calculation may be considered very near each other; but allowing for the land not under irrigation, and that supplied by wells, we shall find that a discharge of one cubic foot of water per second would supply an average of 1700 cubic yards of water an acre to 700 acres of culturable land; or supposing the discharge of the Indus in December to be 40,857 cubic feet per second, it would only require 1-28th of this quantity to irrigate 1,000,000 of acres of culturable land. Supposing one-third of this area to be under cultivation from irrigation at one and the same time, allowing a discharge of 1480 cubic feet per second to be sufficient for 1,000,000 acres, this would require a supply of less than 200,000 cubic yards an hour, which it would therefore be sufficient to provide for; supposing that 1,000,000 of culturable acres are to be provided for, and that the canal is only to be used for irrigation.

Now the profits derivable from works of irrigation consist evidently in the difference of cost at which water can be stored and supplied, and that at which it can be supplied to the natives. On this point we have a great deal of information afforded us in the valuable work of Colonel Cotton, chief engineer at Madras, entitled "Public Works in India," in which he says, that in the Madras Presidency, water is valued and sold at the rate of 500 cubic yards per rupee, and gives an instance of its being raised, by a poor man for his own small garden, at a cost to him of labour of 560 cubic yards to a rupee; 500 cubic yards per rupee may, therefore, be taken as the price at which it may be sold to the natives with profit to them; and we are informed that there are thousands and thousands of cultivators willing and anxious to purchase it at that rate. Now, if we turn to the rate at which it can be stored and supplied by large works of irrigation, we find from the same authority, that by the weir across the Godavery, water will be obtained

at the cost of one rupee for 30,000 cubic yards; "and here," says Colonel Cotton, "we cannot much err, as the works are so near completion, as to enable a very close estimate to be made of the actual expense attending a certain supply of water." "We there find," says Colonel Cotton, "that upon a large scale, water can be provided in India at one-fiftieth part of what it is worth; that Government do actually obtain it at about 30,000 cubic yards for a rupee, and that when applicable to the land and to navigation, it is worth at least one rupee for 500 cubic yards." "Is it then surprising," he continues, "that on an average all the new works of irrigation executed in Madras within the last 13 years yield 100 *per cent.* to Government in direct revenue, besides that which is obtained indirectly, namely, from the increase of duties arising from the improved condition of the people; or that in Tanjore, one million and a half has been added to the saleable value of the lands since the construction of the Coleroon Weirs?"

In the Western Jumna Canals, allowing 4 *per cent.* on the amount expended in their construction, water is obtained at the rate of 18,000 cubic yards per rupee, by means of loose tanks or reservoirs on the hills or other suitable spots. Colonel Cotton reckons that water may be stored at 28,000 cubic yards per rupee, and in the Great Ganges Canal it will cost one rupee for 7300 cubic yards, or,

	Cubic Yards.
By the works on the Godavery, at ... ..	80,000 per rupee.
By large reservoirs ... ..	28,000 "
By the Western Jumna Canal ... ..	18,000 "
By the Great Ganges Canal ... ..	7,300 "
Estimated result of Punjab Canals ... ..	18,000 "

The cause of this excessive cost in the North-west Provinces being partly from the difference in the nature of the works necessary there to head the water to the surface of the land, and partly from the works being executed upon a more expensive plan. With such facts as these, we may cease to wonder how it is that works of irrigation in India yield 100 *per cent.* profit on the expenditure.

We find from Captain Baird Smith, that the Western Jumna Canal *yields only 38 per cent.* on the amount of capital required for its construction, whilst the Eastern Jumna Canal returns *only 24 per cent.* But the cause of these *small returns* may, in a great measure, be accounted for, not only by the more expensive nature of the works, but on account of the very low rate at which the water appears to be supplied to the cultivators in the North-west Province—a rate clearly far beneath what it is actually worth to them; for whilst the supply of water from these canals is, as has been above shown, only one rupee for 5000 yards of water for the land actually irrigated, it is worth to the

cultivator, at the highest estimate, 600 cubic yards per rupee, taking the average quantity of grain produced per acre as 600 lbs. in excess of that grown on lands not irrigated; which, at 1 rupee per maund of 80 lbs., 1s. for 40 lbs. of wheat, &c., gives an increase in the value of the crop of 8 rupees per acre; from which, however, has to be deducted the small extra cost of cultivating irrigated land over that not irrigated; and if this is put down at 2 rupees per acre, it will leave 6 rupees as the value of the water per acre, for which the cultivator is charged 1 rupee only; so that the cultivator really gets the water at one-sixth the price of what it is actually worth to him.

Having now shown at what rate water is obtained and sold for in the North-west Provinces of Bengal, and in the Madras Presidency, we have next to apply these data to Scinde, the scene of our proposed works, and see what, if any, modifications are required to make them suit that locality.

Colonel Cotton estimates that canals fit for the navigation of steam boats may be constructed for £2000 per mile in length, and mentions that the Ganges Canal, of nearly 900 miles long, is estimated to cost about £1,600,000, or something under that sum. Captain Baird Smith, in his pamphlet on the agricultural sources of the Punjab so often quoted, gives £1,250,000 as the probable cost of the Ganges Canal for a length of 898 miles, which would be at the rate of about something under £1400 per mile.

There is some difficulty in understanding Captain Smith's account of this work in this instance, as in a subsequent paragraph he states:—That the Ganges Canal is estimated to cost (as a canal of irrigation only), nearly 6000 rupees, or £600 per mile, which sum would require to be doubled, if not trebled, to bring it up to the total estimated cost of £1,250,000 or £1,600,000.

But that the smaller sum of £600 per mile may be considered sufficient for a canal of irrigation, such as that of the Ganges, we must infer, from its being taken as the datum for estimating the probable cost of the proposed canals in the Punjab, which are consequently put down at 4000 rupees, or £400 per mile, for a discharge of water of 3000 cubic feet per second; sufficient to irrigate two millions of acres of land, and at which rate of total cost these canals are estimated by Captain Smith to return 27 per cent. on the invested capital, calculating at a water rate of only 1 rupee per acre of ground actually irrigated, or only 1 rupee for  $3\frac{1}{4}$  acres of irrigable land, or at the extraordinary low rate of 5000 cubic yards of water per rupee; being ten times that stated by Colonel Cotton to be the quantity per rupee which water is valued at and sold in the Madras Presidency.

Before applying these rates to Scinde, we must consider whether the rates of labour are the same in that province as in the localities of the canals we have been referring to. Now we believe labour to be cheaper in Bengal than in Scinde (Lieutenant-Colonel Scott says that it is 50 per cent less), but in his report on the canals and forests in Scinde he quotes Major Cantley's report on the Ganges Canal, as giving 3 rupees per 1000 cubic feet, or about  $4\frac{1}{2}$  annas per 100 cubic feet, as the rate of excavating that great work; and if we then turn to Lieutenant Chapman's recent estimate for a canal from Kurrachee to Kotree, we find the excavations charged at 5 annas per 100 cubic feet, so that there would not appear to be much difference in the actual cost of such labour, particularly as in some Bengal estimates for their railways the charge for earthworks is  $6\frac{1}{2}$  annas per 100 cubic feet.

If we compare the prices of masonry, we find that in Lieutenant Chapman's most detailed estimate it is given at 15 rupees per 100 cubic feet for stone-work for his locks, &c.; whilst the charge for brickwork on the Bengal railway, as given in the *Friend of India* for March, 1853, amounts to 22 rupees per 100 cubic feet, so that in masonry works there may be expected to be a saving in Scinde.

Now if we take Captain Baird Smith's estimate for irrigating canals in the Punjab at 4000 rupees a mile for a discharge of 3000 feet per second, the profits on such a work would be enormous; for charging at the rate of only 1 rupee per acre for all the land actually irrigated, or at the rate of 5000 cubic yards of water per rupee, the clear dividend on these Punjab canals is shown to amount to 26 per cent., which dividend would, and might be made *fourfold*, if the water were charged for at a rate at all assimilating to that in Madras, or such as to give a fair profit to the cultivators.

If we compare the two countries as to their comparative physical difficulties in cutting a canal, we shall not, we think, find them to the disadvantage of Scinde. Supposing a canal to be carried from the Indus at Roree opposite Sukkur, in the direction of Hyderabad, it would pass through a district peculiarly free from irregularities or undulations of surface, and, following the general drainage of the country, it would be but little intercepted by water channels. Indeed, Lieutenant-Colonel Scott, in his report, mentions the branch, or nullah, called the Fooleli, as the only channel of any importance leaving the left bank of the river, between Sukkur and Hyderabad; and the large map of Scinde, published so lately as the year 1850 by the Quartermaster-General's Department in Bombay, does not show a single nullah, or water-course, of sufficient importance to be inserted

in a map on a scale of 8 inches to the mile, nor anything resembling a range of hills, or unusual undulation on the left bank of the river. Indeed the river, in this part of its course, keeps entirely to the eastward of all the water-sheds of the country, its right bank being bounded by ranges of hills, approaching close to its margin in the neighbourhood of Sehwan, and rendering the ground uneven, and intersected by water channels.

The fall in the Indus from Mithenkote to the sea is reckoned at about 6 inches to the mile; but as the fall through its Delta, or between Hyderabad and the sea, is very much less than this, probably not above 4 inches to the mile, and the fall from Mithenkote to Sukkur may be a trifle more than 6 inches, we may assume 6 inches as the fall of the river in the parallel of the canal; but the distance by the river from Sukkur to Hyderabad cannot be less than 250 miles, whilst by the direct course our canal would take it would not probably be more than 180 miles, which would give a fall for the canal of about 8 inches per mile, which is somewhat less than in the North-west Provinces of Bengal, where of course the rivers are nearer their source, but still sufficient for the purpose.

In the canals in the North-west Provinces, a supply of water equal to 8 cubic feet per second is considered sufficient for each mile of canal in full activity, so that for a canal 180 miles, or say that we allow it to be 200 miles in length, a discharge of 1600 cubic feet per second would be sufficient.

For a discharge of 3000 cubic feet per second, and a canal 350 miles in length, the sum of 4000 rupees per mile is considered sufficient in the Punjab. As the velocity in our canals would not be equal to what there obtains, a larger sectional area would be required, of course increasing the expense; but if we allow 6000 rupees or £600 per mile, which is the sum quoted by Captain Baird Smith, as that of the Ganges canal (as a canal of irrigation only), for a discharge of 6750 cubic feet per second, it must surely be ample for a canal under 200 miles in length, and merely for irrigating purposes, in Scinde.

It has been estimated by those intimately acquainted with the country, that there are at least 1,000,000 of acres of land capable of being cultivated by irrigation in the line our canal would pass through, and which would give a breadth of only about four miles on each side of the canal, for which no branch canals would be required, but merely the ordinary water-courses; though it is more than probable that, as the country increased in prosperity and population, it might be found necessary to run another canal parallel to the first, so as to embrace



a greater breadth of irrigated land. This is merely considering the subject as one of irrigation; if the canal is made one of navigation also, like the Ganges Canal, there would be a great difference in its details; but we may first refer to the requirements of a navigable canal in Scinde.

Lieutenant-Colonel Scott, in his report on the canals and forests in Scinde, says, "There are no roads whatever in Scinde, except those made by the British Government in cantonments. There is not a single cart in Lower Scinde, but in Larkana and Shikarpoor, there are a few of very rude construction; the consequence is, that the people lose a market for all their coarser and more bulky produce, such as kirbee. "I saw," says Colonel Scott, "in last December, large fields of kirbee, about 20 miles east of Tatta, from which the people had merely cut the heads, and then turned the cattle in to feed upon the leaves, and this at a time when fodder of the coarsest kind was excessively dear at Kurrachee."

Major H. B. Turner, the superintending engineer of Scinde, in his letter of the 15th November, 1853, says, "At Kotree I found stocks of Government grain of *three years'* standing, which, though repeatedly submitted to public auction, nobody would buy, in consequence of the cost of conveying it to a market; *the grain was eventually destroyed by the inundation of 1851.* Nothing more need be said of the necessity of providing improved means of transit in Scinde.

The navigation of the Indus, the only available means of transit for heavy loads in Scinde, except the expensive one by camels and ponies, is at all times precarious and dangerous; whilst at certain seasons it is almost impracticable, so that it cannot be doubted that much requires to be done in that country to improve its means of internal transit. That much will be done in this line by the present enlightened and philanthropic commissioner of Scinde, so ably seconded as he is by the talented head of the engineer department in the province, there is little doubt; but as it is useless to prepare measures for improving the resources of a country, unless the means of conveying the superfluous produce there obtained to a market are provided, there is every reason to believe that it will be far more advantageous to all parties to make our proposed canal, one of navigation as well as of irrigation, than to suit it to the latter purpose only.

We are aware that it is in contemplation to construct a railway from Kurrachee to Katree on the Indus, which might at some future period be extended to Sukkur, &c., but, under any circumstances, it would be a very long time before this could be carried into effect. For the transit of heavy goods and agricultural produce, there can be very little

doubt of the advantage of canal over railway carriage in *India for long distances*, where the nature of the country is suitable for such works. Colonel Cotton, in his "Public Works in India," has devoted a great portion of his book to a consideration of this subject; but it is merely necessary for our purpose to quote some of the leading facts. The cost of transit on the Rajahmundry canals is, *at present*, 1 pie or 1½ pie per ton per mile, though they are far from being in complete order, and this is for very short trips; but for distances of 200 or 300 miles, the cost there will not exceed half a pie, or *one-fourth* of a farthing, per ton per mile. This is what is *done*, and it is expected that the Great Ganges Canal may convey goods at the same rate, the present price by the river Ganges being 4 pice, or one halfpenny, per ton per mile. It is surely useless after this to multiply examples, but we may refer to America to show that canal transit is not incompatible with the use of railways; and, in fact, the introduction of the latter into a country in no way affects or interferes with the use of the former for the conveyance of *heavy goods for long distances*. On this point the results of railway transit in this country affords no data, as the average distance goods are conveyed in England by rail is so small as not to affect the question when *long distances* are concerned. Colonel Cotton, quoting Dr. Lardner and Mr. Mackay, shows that the average distance that goods are carried by rail in America is only 38 miles, and that, in fact, where goods cannot be carried by water they are not carried at all, except for very short distances; and so far from the introduction of railways in a country having interfered with that of canals, it appears that the Erie Canal, from Lake Erie to Albany on the Hudson, 365 miles, worked by horses, was first cut in 1822, at a cost of about £1,500,000, and in 1840 (ten years after the value of railways was clearly seen) its enlargement was commenced, and carried out at a cost of upwards of £5,000,000 sterling more, making its total cost about £18,000 per mile, or, according to Dr. Lardner, £13,700 per mile, whilst the average cost of railways in America is about £8100 per mile; so that, after the effects of railways were fully known, a canal was enlarged at upwards of three times its original cost, and at a total charge per mile of more than one-and-a-half times that of a railway, in a country where frost stops water communication nearly half the year.

In Scinde, according to Lieutenant Chapman's Tables, the cost of land carriage, that is, by camels and ponies, is an average of 2½ annas, or 3½d. per ton per mile; whilst that on the river Indus is only one-third of an anna, or ½d. per ton per mile; with which latter a railway could not compete as far as mere *cost of transit* is concerned.

Whether, therefore, railways are, or are not, introduced into Scinde, will not, we imagine, effect the desirableness of making our proposed canal one of *navigation* also.

Captain Baird Smith says that the cost of adapting a canal of irrigation for transit is about one-twentieth of the entire outlay required; but this is evidently too low an estimate, for the same authority only allows £600 per mile for the Great Ganges Canal, as a canal of *irrigation only*, whilst it will cost nearly £2000 per mile as a canal of navigation and irrigation. In the report of the late Lieutenant Chapman, for a canal from Kurrachee to Jerruck on the Indus, the estimate for the work is given in such detail as to demand our consideration, particularly when it is proposed to commence our operations in that very country. The object of this canal was "the substitution of a direct and effectual means of communication between the Indus and Kurrachee (the seat of Government in Scinde), for the uncertain, difficult, and tedious route which the river and its tidal channels at present afford." The length of the canal was to be 92 miles, exclusive of a cut 3 miles in length to connect it with the harbour of Kurrachee, and the total amount of the estimate was £485,077 for the canal, cut, basin, dock, &c.; of which £448,659 was for the canal, or at the rate of something under £5000 per mile.

As Colonel Cotton only allows £2000 per mile for the cost of constructing steam canals in India, and as the Great Ganges Canal, by far the largest work of the kind yet carried into execution, will only, it is anticipated (and it is now near its completion), cost £2000 per mile, it is necessary to inquire into this extreme rate of £5000 per mile, calculated upon by an officer of so much talent and experience as the late lamented Lieutenant Chapman. It may appear somewhat out of place to enter into such a discussion here; but it will be seen by those who understand the subject to be absolutely required; for it is obviously necessary, in asking for the support of the public to our undertaking, that we should be able to show just grounds for expecting success, derived from sources that cannot be questioned. It will be admitted that in the absence of any local examination of the ground, surveys, &c., the only means at our disposal for forming a correct estimate of the probable cost of a canal in Scinde, and of the probable returns from it, is to take the cost of executing other similar works in other or similar localities. And as the canals in Bengal, and in the North-west Provinces, and the works of irrigation in Madras, are the only ones that have been completed, and of which the results are known, we have taken them for our data, and comparing the price of

earthwork and masonry in the different localities, have shown the vastly profitable nature of the undertaking, as a canal of irrigation only.

But were we to assume at once the data there provided us for canals of navigation, and apply them to Scinde, we might be met by the statement, that a canal of navigation in Scinde had been estimated at a cost of no less than £5000 per mile, and therefore that the experience furnished us by the Ganges and Jumna Canals would not apply to Scinde.

Lieutenant Chapman's canal has a mean breadth of section of 68½ feet, with a depth of 7 feet, or a sectional area of 480 square feet; which, as its dimensions were regulated to suit the size of the boats by which it was to be navigated, is continued throughout its course.

Now, the Ganges Canal has at its extreme section a breadth of 140 feet at bottom, with side slopes of 2 to 1, and, we believe, a mean depth of 8 feet; but, being a canal of irrigation, its sectional area decreases as it sends off its water for irrigation along its course; its average section being, we believe, about 90 square yards, whilst that of the Kurrachee Canal is only 53½ square yards; so that its difference in cost, already so great, would have to be corrected in its diminished section.

Now, of course, the expense of a canal must in a great measure depend upon the nature of the surface of the country through which it passes. We have no means at hand of ascertaining this as regards the Ganges Canal, except that we believe the works at its head were very heavy, but not generally along its course; in the case of the Kurrachee Canal we have more precise data.

The sectional area of the canal is 480 square feet, which at 5 annas per 100 cubic feet of excavation gives 1½ rupee, or 3s., per lineal foot of section, or nearly 8000 rupees, or £800, per mile, supposing that the canal required merely its actual section to be cut. But the estimated cost of the earthwork for this canal is no less than £2554 per mile, or three times that due to its actual section, which is accounted for by finding that the excavations alone for 70 miles are *double* what are due to the mere sectional area of the whole canal; whilst for 23 miles of embankment, where there is no excavations, the charge is at the rate of £3500 per mile for them, and the piséwork by which they are made water-tight.

In the first 12 miles of cutting the excavations amount to 4½ times the mere sectional area of the canal, whilst in 12 miles of embankment, these latter are nearly *four* times the area of the section, and ten times the cost of excavation due to that area. An examina-

tion of the locality shows the reason for this great increase in actual work over that shown by the mere sectional area of the canal to be, that it *crosses* the *drainage* of the country, requiring no less than 12 large aqueducts to carry it across rivers or water channels, at an aggregate cost of £125,475, or upwards of *one-fourth* the total sum allowed for the canal. This crossing the drainage of the country also causes the surface to be very undulating in parts, thus necessitating deep cuttings and high embankments, the latter being by far the most expensive operation of the two. In this case this could not be avoided, as by so carrying the canal it lessened the distance from 230 to 110 miles of water transit. But, as has been before observed, the line of country through which our canal would pass, on the left bank of the river, being free from all these objections, there is no reason to suppose that its average cuttings or embankments would exceed those of the Ganges or Jumna Canals, in proportion to the sectional area adopted, and as the rate of excavation has been shown to vary only as 5 to 4½ annas per 100 cubic feet, whilst the cost of masonry is in favor of Scinde as 15 to 22 rupees per 100 cubic feet, we think we have shown good grounds why, whilst adopting Lieutenant Chapman's rates of work, we need not be bound by the total cost per mile of his canal, in which the total quantity of earthwork is more than three times that due to the mere sectional area of the canal, and more than *four-fifths* of the whole estimated cost is for masonry aqueducts across rivers and water channels, due to the peculiarity of the nature of the country his canal is obliged to traverse. We do not think therefore that we should much err in allowing £2000 per mile as the cost of a canal of irrigation and navigation in Scinde.

Moreover, the canal, as designed by Lieutenant Chapman, is on the principle of a dead level, the fall between the assumed lowest level of the water of the Indus for canal supply, and the high-water level at Kurrachee, amounting to 31 feet 6 inches, being disposed of by three locks, of 8, 5, and 9 feet fall, which, after deducting the depth of water in the canal of 6 feet, left the height of the canal bottom above high water mark, on arrival at Kurrachee, 3 feet 6 inches.

Now, such a construction as this must evidently necessitate a much greater amount of earthwork than where the canal follows the general inclination of a country, which it would do in the line between Sukkur and Hyderabad, where the fall is regular, and only from between 6 and 8 inches a mile, which is somewhat less than is considered necessary in the North-west Provinces, for the supply and distribution of the water, so as to secure a velocity of current adequate

both to the demand for water and conservancy of the beds, by preserving them from the effects of tropical vegetation. For such a fall no locks would be required, as 6 inches a mile has been found not to be at all too rapid a descent; 3 feet a second being about the minimum velocity in those canals. The great Ganges Canal, with a sectional area of between 80 and 90 square yards, and discharging 6750 feet per second, must have a velocity of 8 feet per second.

So that a canal, reduced to a series of levels, by means of locks, and crossing the drainage of the country, must, of necessity, be a much more expensive undertaking than a canal following the general inclination of the country, and that country unbroken by hills or undulations.

As to the extent of traffic now passing through Scinde, or what it may be expected to amount to, we may state that this country is every day growing into importance, and is gradually becoming the highway from England to the Punjab and North-west Provinces of India. Vessels from England are now freighted direct for Kurrachee, and nothing is wanted but an improvement in the internal transit of that province to secure it as the direct road to and from the mother country.

According to Lieutenant Chapman's returns, if we take the number of vessels passing Kotree, or those which pass up and down the river, we find that an amount of 32,345 tons passes that place annually in native boats, to which must be added 422 tons of private merchandise conveyed by the Indus flotilla, and 2681 tons of overland traffic, giving a total of 35,448 tons of goods carried through the country annually. In forwarding Lieutenant Chapman's report to Government, Mr. Frere, the commissioner in Scinde, says this traffic is increasing steadily at the rate of 20 per cent. per annum, and will, in all probability, by the unaided result of causes now in operation, be 60 or 80 per cent. greater than at present, before the railway between Kurrachee and Kotree can be possibly opened, however speedily it may be commenced. So that there is every reason to suppose that by the time our canal could be brought into operation, there would be a traffic of between 75,000 and 100,000 tons passing along the course it would take.

There are many other points connected with the construction of a canal in Scinde which might be referred to, and regarding which much useful information might be quoted from the report of Lieutenant-Colonel Walter Scott, of the Bombay Engineers, on the canals and forests of Scinde, as well as from the notes and oral testimony of several distinguished officers who have held high official situations in the province. But as the object of this essay is merely to point out, in

general terms, the advantages to be derived from an extended system of canal irrigation and navigation in India, and its peculiar adaptation to Scinde, it would swell these pages, already extended, to too great a length, far too much, were we to enter into more particulars or details, which it will be time enough to do when our project is carried into execution, and which will, we trust, be accepted as an apology by those intimately acquainted with the subject and the locality, for much detail and local adaptation to meet the peculiar circumstances of the case that might otherwise have been given.

We cannot, however, close our allusions to the very excellent report of the late Lieutenant Chapman, without offering our humble tribute to the memory of one, whose amiability of personal character as much endeared him to his numerous friends, as did his high acquirements and talents, and his unbounded zeal and energy win for him the well-merited acknowledgments of the Government he served; and irreparable as his loss must be to those by whom he was beloved, it is scarcely less so to the State, who will find it difficult to supply his place. He died a victim to the treacherous navigation of the Indus just one month after the date of his last report on the Kurrachee Canal and Railway, leaving a name that will long be remembered with regret and pride by his brother officers.

Although we have confined our present remarks to the construction of a canal in Scinde for reasons previously given, there are many localities in Western India where similar works might also be most advantageously carried into effect, the junction of the rivers Narbudda and Taptee, through the rich cotton grounds of Guzrat, offering, perhaps, as eligible a spot for the construction of such a work as could be desired. But were the Company we propose to form, once established, all those points would, as a matter of course, be taken into consideration.

Neither is there any necessity for confining our operations solely to the cutting of *canals*. Many districts are most unfavourable for such works, and in such localities the storage of water may be much better accomplished by erecting weirs or dams across rivers, such as has been done in Madras, across the Godavery, the Colleroon and the Cavery; and indeed this method of obtaining a supply of water appears to be somewhat the cheaper of the two, though, from the rugged and rocky nature of the beds of most of our western Indian rivers, especially near their source, and the rapidity of their fall, it is doubtful if they can, at any reasonable cost, be made as available for navigation as canals.

In the foregoing observations, while we have shown the great profits

derived from irrigation by canals and rivers in different parts of India, and the reasons why they might be undertaken with equal advantage in Scinde, we have abstained from drawing out any direct estimate of expenditure and dividend, because the latter must, in a great measure, depend upon the price at which the water is to be sold to the cultivators. We are not aware that the water from the present system of canal irrigation in Scinde is sold at all to the natives, but rather think that the profit from them is obtained by an increased revenue from the irrigated lands. In Bengal there appears to have been two systems, one by measuring the land actually irrigated, and then charging according to the nature of the grain grown, and the manner in which the water is supplied; and the other, by the area of the outlet of water; under both systems the average rate at which water is supplied being about 1 rupee or 2s. an acre, equivalent to 5000 cubic yards per rupee. There is, however (says Captain Baird Smith), no branch of the canal system which so imperatively requires reforming as the assessment.

In Madras, according to Colonel Cotton, water is charged for at the rate of 500 cubic yards per rupee; and, says that officer, "millions of cubic yards of water were purchased annually in that Presidency at prices varying from 100 to 300 cubic yards per rupee, the cost of raising it from wells and rivers;" and that for the cultivation of sugar alone, the value of the water to the cultivator is 50 rupees, requiring 15,000 cubic yards per acre, for which, at the rate of 500 cubic yards per rupee, he pays 30 rupees, leaving 20 rupees per acre as profit; and adds, "In this way, tens of thousands of acres in the Delta of the Godavery, where nobody until lately thought of growing anything in the hot season, are now, in consequence of a supply of water being at command, covered with crops of oil seeds and other things; so that the price, 500 cubic yards per rupee, at which it is now purchased, is an unanswerable proof of its being worth more than that."

That the rate at which it is charged in the North-west Provinces is far too low, is, therefore, apparent, and may arise, in some measure, in consequence of the extreme cheapness of grain in those districts where a maund of 80 lbs. of wheat, &c., sells for 1 rupee, or nearly 3½ lbs. for 1d. With food so cheap, the water must necessarily be cheap; and again, the extreme distance of the Upper Provinces of Bengal from a shipping port must seriously interfere with the growth of any produce for exportation; whilst in Scinde, with a canal or railway from Kotree or Jurruck to Kurrachee, in connection with a canal from Sukkur to Hyderabad, and direct communication with England by sea from the



port of Kurrachee, with a rich soil, yielding 56 bushels of wheat to the acre—the more valuable agricultural productions, such as sugar, cotton, rice, hemp, flax, &c., might, it is believed, be grown and landed in England with greater facility than perhaps from any other part of India, owing to the unusual vicinity of the producing districts to a shipping port.

Although we have in a previous page shown the advantage, in some respects, of making a canal answer both the purposes of irrigation and navigation, it will, should our propositions be favourably considered by the India Government, become a question, whether it would be more advisable to start in the first instance with a canal of irrigation only; for these reasons:—

First, it would not interfere with any project there may be for constructing a railway from Kurrachee to Hyderabad, and continuing it on to Sukkur, &c., thus occasioning great delay in coming to a conclusion as to which mode of transit it would be best to adopt; and—

Secondly, because a mere irrigating canal, made sufficiently large for the transit of the produce grown on its banks, but not for steam-vessels or general communication, is a much less expensive, and more simple an affair than a large steam canal. And as on the first establishment of such a company as we now propose, it is obviously desirable that our first work should come into action and produce a return in as short a time as possible, so as to give encouragement to the further extension of the scheme, and as a canal makes no return until it is completed, it might be more advisable to commence upon, and finish, a comparatively small work *quickly*, then to commence our operations, by undertaking a more important work that would require so long a period to elapse before any returns would be derived from it. And as in Scinde, owing to the few points at which a canal could with facility or safety be connected to the river, the *length* of our canal is in some measure determined, its sectional area must meet the requirements of a speedy completion and moderate amount of invested capital.

To irrigate one million of acres in a length of 200 miles, or for a breadth of 4 miles on each side of the canal, requires no branch canals; and, as we have before shown, if a discharge of 3000 cubic feet per second is sufficient for a canal 350 miles in length, a discharge of 2000 cubic feet per second would be ample for all our purposes, and such a canal might, we believe, be constructed for £600, in the locality we propose for irrigating purposes only, yielding a return of from 25 to 100 per cent., according to the rate at which the water is allowed to be sold to the cultivators.

But as some of our readers may like to see the manner in which the profits on these works of irrigation are calculated, we will give below estimates for such a canal as we propose, framed according to the Madras and Bengal method of charging for the water, premising that it is impossible to give an exact estimate, in the absence of all surveys and examination of the particular country through which the canal would pass.

There are, according to the best authorities, at least one million of acres of land on the left bank of the Indus, capable of being watered by artificial irrigation, a great portion of which, in the collectorate of Hyderabad, is held by *Jagheer*, and the Jagheedars would, according to the testimony of the late collector of Hyderabad, (the very best possible authority on the subject), hail with pleasure the formation of a company such as we propose to establish, and cordially co-operate with it. If from these one million of acres, is deducted one-third as occupied by villages, trees, &c., and land unfit for irrigation, and then only one-half of the remainder is taken as likely to be under irrigation at one and the same time, we shall have about 350,000 acres of land to be annually irrigated; and supposing, for reasons already explained, that 3000 cubic yards of water per acre is ample for the average of all crops, about 1000 million cubic yards of water must be annually provided, requiring a discharge of 1000 cubic feet per second, or about half that of the Western Jumna Canal, which, according to Captain Baird Smith, cost only £250 per mile, from which he estimated the cost of the canal in the Ravee Doab of the Punjab at £400 per mile, for a discharge of 3000 cubic feet of water per second. But allowing a greater area of section to our canal, as having a less velocity than those in the Punjab, or only about 4 feet per second, if we reckon £600 per mile *or half as much more* as that for the Ravee Canal, with a discharge of *three times* that of ours, we must surely be on the right side, making ample allowance for the larger works at the head of the canal, and at its rejunction with the river.

The estimate then becomes one for a canal of irrigation *only* :—

200 miles of canal at £600 per mile	...	...	...	£120,000
1000 millions cubic yards of water at 1000 yards per rupee	...	...	...	100,000
Deduct £40 per mile for repairs and management	...	...	...	8,000
Left for dividend	...	...	...	£92,000

or 76½ per cent. on original expenditure. Here the water is charged at only *one-half* what Colonel Cotton allows as its value in Madras; and

the charge for repairs, management, &c., is the average cost in the united Jumna Canals, or about 8 per cent. on the total cost.

But if we suppose the canal adapted for navigation also, the probable cost would be, as shown in a previous page, about £2000 per mile. We have, then,

200 miles of canal at £2000 per mile	...	...	...	...	£400,000
Clear water rent as before	...	...	...	...	92,000
75,000 tons of goods carried 200 miles at 1d. per ton per mile	...	...	...	...	£82,500
Deduct cost of steam transit at 2 pice or 0½d. per ton per mile, including repairs, &c.	...	...	...	15,600	46,900
Or for dividend	...	...	...	...	£138,900

or 34½ per cent. on total outlay.

Colonel Cotton says, that goods might be carried on steam canals for one-third of a pie per ton per mile; we have allowed 2 pice, or six times that sum.

From this it appears, that the dividend is greatly diminished by making the canal one of transit also, where water is sold, as it is in Madras, by the cubic yard.

If we now apply these calculations to the Bengal system of charging by the acre of land irrigated, we have,

200 miles of canal, at £800 per mile	...	...	...	...	£120,000
Water rent on 350,000 acres at 1 rupee per acre	...	...	...	...	35,000
Deduct £40 per mile for repairs and management	...	...	...	...	8,000
Left for dividend	...	...	...	...	£27,000

or 22½ per cent on invested capital.

If we make the canal for navigation also,

200 miles of canal, at £2000 per mile	...	...	...	...	£400,000
Clear water rent as before	...	...	...	...	27,000
Clear rent from transit of goods	...	...	...	...	46,900
Or for dividend	...	...	...	...	£73,900

or 18½ per cent. on original outlay. So that in either case it appears that it would be much more profitable to make canals in Scinde *solely* for irrigation, until the transit of goods is much greater than it is at present.

These estimates will give an idea of the manner in which the profits on canals in India are calculated; and when we know that in the North-west Provinces of Bengal such canals *do* produce 28 per cent. clear profit, that those in the Punjab are estimated to produce 26 per cent., and that those in the Madras Presidency, where the water appears

to be charged at a rate much more commensurate with its real value to the cultivator, the profits are from 70 to 140 per cent. on the total outlay, it will be admitted, that these estimates, rough as they are, must give a tolerably near approximation to the truth.

The advantage to Government is as great, if not more, than that of the water-seller; the Jumna Canals produce a return of *increased* revenue equal to the rent charged for the water; and Captain Baird Smith estimates the probable revenue from that portion of the Punjab, contained between the rivers Beas, Sutlej, and Jhelum, containing an area of 24,000 square miles, proposed to be irrigated by canals, at £3,400,000, or £141 per square mile, which from a return given of the present revenue of those districts is only £30 per square mile, the usual increase in land revenue from works of irrigation being reckoned at £45 per square mile.

It appears, therefore, from the foregoing estimate, that if the *direct* return from a canal is *alone* taken into account, that it would be more profitable to confine it to a work of irrigation only (except such transit by small barges drawn by cattle, as may be required for the carriage of the produce grown on its banks), whilst the first cost will not be one-third that required for a canal of navigation; and it could be completed and brought into use in a proportionably less time.

But as the sectional area of a canal of irrigation at its head, or where it leaves the supplying river, must depend upon the *length* the canal is to have; where this length is very great, as in the Ganges Canal, the cost will not be so greatly raised by adapting it for transit as well as for irrigation, as in a smaller work.

That such a canal as now proposed might be commenced and completed in a moderately short period, may be judged of from the fact of the rapidity with which large works can be carried on in India where necessary. The great aqueduct across the Solani river, in the line of the Ganges Canal, employed 6000 men daily, and was estimated to require ninety millions of the large bricks of the country and one million cubic feet of lime; and Colonel Cotton mentions that two masonry weirs across the Colleroon, one 800 yards, the other 680 yards in length, were *both* completed in *three months*; one branch of the Godavery weir, 900 yards long, was carried across in a fortnight, to such a state of completion as to allow of the water going over it.

The Nuggaram aqueduct, over a branch of the Godavery, 800 yards long, and containing 49 arches of 40 feet span, was built in a tideway, and the last arch keyed within four months of the time of commencing to make the bricks. This work is 28 feet broad, and was ready for the

water to go over it in about seven months from the same time—facts which speak for themselves. We have now, we hope, said sufficient to show the unprejudiced reader the value of water irrigation in India, the vast field which is opened for the extension of what now exists there, and the profitable nature of such works, together with the peculiar advantages offered in the Province of Scinde for commencing upon an undertaking of the kind ; from its rich soil, the want of regular periodical rains causing almost its entire cultivation to be dependant upon artificial irrigation, the ample supply of water in the Indus, which, when at its lowest, discharges upwards of 40,000 cubic feet per second, the favourable nature of the country through which the canal would pass, and the extreme facilities for conveying such produce as is suited for exportation to England.

Referring our readers to the proceedings of a meeting of gentlemen interested in the subject, on the 29th ultimo, appended to these remarks, we confidently leave our case to the decision of impartial judges.

## MEETING ON INDIAN IRRIGATION.

A MEETING took place on Saturday, April 29, at 2, Moorgate-street, of gentlemen proposing to associate themselves for the purpose of obtaining Canal Irrigation for India. Amongst those present were Mr. Sullivan, late Member of Council, Madras; Col. Grant, Superintending Engineer of the Deccan; T. Williamson Ramsay, Esq., late Revenue Commissioner, Bombay; Gregor Grant, Esq., Bombay Civil Service; Alderman Kennedy, Dr. James Burnes, K.H., late Physician-General of the Bombay Army; Major French, late Officiating President at Baroda; Dr. G. Buist, F.R.S.; Capt. Rathborne, late Collector and Magistrate of Hyderabad, Scinde; G. Inverarity, Esq., late Officiating Collector in Upper Scinde; Capt. H. L. Evans, late Political Agent, Nimar; Capt. Ward, Bengal Army; James Matthews, Esq. of the firm of Grindlay and Co.; T. A. Yarrow, Esq., Oxtou Hall; F. H. Valliant, Esq., Bombay Cavalry; and Capt. Whitton, Bombay Army.

On the motion of Mr. SULLIVAN, Col. Grant was called to the chair; and the chairman having explained the objects of the meeting, called on Dr. Buist, by whom it had been summoned, to give an outline of his scheme. Dr. Buist then proceeded to read the following statement:—

He observed that, although the traditions of the vast extent and value of the canal operations of former days, must have been familiar to the English, from their first connection with India, and the impression was nearly universal as to the almost unbounded importance and lucrativeness of canals of irrigation, it was not till 1849 that anything like an exact estimate could be made of returns always believed to be enormous, and which the articles in the *Calcutta Review*, the pamphlet of Major Baird Smith, and the long succession of important papers which followed them, first sufficiently defined. From these various documents the following extraordinary facts appear:—

From the Jumna Canal, Government derives a revenue of £25,000 a-year from a total investment of £90,000; from the Western Jumna Canal (an investment of £140,000), a direct revenue of £44,000 a-year arises. Lands previously comparatively barren are maintained in a state of constant productiveness for a water-rent of 2s. an acre. The

population maintained in the irrigated districts is very nearly double, mile for mile, of that of those not irrigated. A careful computation made by authority, shows, that in the famine year of 1837, the gross value saved by the Eastern Jumna Canal was half a million sterling, one-tenth of this being revenue, or £50,000, direct gain to the public treasury. The united Jumna Canals saved at the same period above two millions sterling to the Commonwealth. On the canals in the North-West Provinces, completed between 1821 and 1848, Government expended £557,000, and drew in direct canal revenues £546,000. By this an area of nearly 1,300,000 acres of ground, previously sterile, have been made to yield produce worth two and a half millions annually, and to support upwards of six hundred thousand human beings. The Sutlej Canal, now in progress, is expected to water 624,000 acres, and to yield Government a revenue of £55,447, on an expenditure of a quarter of a million, or nearly 20 per cent. It has been estimated by the Bengal Engineers, that water and land available for the purpose of irrigation in these neighbourhoods, would, on an expenditure of two millions, afford a permanent return of £578,150 annually, or close on 30 per cent; and that a surface of nearly nine millions of acres, or above ten thousand square miles, might thereby be brought into cultivation. The most magnificent of all the works of this sort is the Grand Ganges Canal, navigable for nearly 900 miles, and on which a million and a quarter has been sunk. It is expected to yield a return of £400,000 a-year, of which £180,000 will be direct revenue; it will fertilise no less than five millions and a half of acres of land now in a state of comparative sterility; increase the gross produce by upwards of seven millions sterling annually in value, and relieve a population of above six millions of all fear of those frightful famines by which the country was wont to the decimated.

Turning next to the canal operations in the Punjab; the principal canal for watering the Ravee Doab will leave the Ravee some miles from Shahpore, following the line of highest level right through the centre of the Doab, and will rejoin the river about 60 miles above Mooltan, a little above its junction with the Chenaub. Two branches will flow off from the main trunk to the south, both limited by the Sutlej, one watering the country in the direction of Sobraon, the other in that of Kussoor; one branch to the north irrigates the land around Lahore, and so along to the southward of the Ravee, between the river and the main canal. The length of the trunk and its branches is no less than 450 miles, and it will serve the purposes both of navigation and irrigation. The work will cost, it is believed, half a million

sterling ; it will irrigate about 545,000 acres, at present in a state of complete sterility. It will cost for its maintenance about £20,000 a-year, and yield a free return of £120,000, or 24 per cent. on outlay after meeting all charges ; thus repaying the cost within five years, and leaving us a clear increase of £120,000 on our revenue from this single department.

The Madras Government has within these six years spent £130,000 on works of irrigation on the Godavery, and has already received £200,000 in direct return in the shape of increase of land revenue. Of course, at the outset, while the works were in progress, the receipts were inconsiderable. The average revenue for a period of six years, before the work began, was £190,000. It is now £300,000 ; so that a third more than the entire original outlay having been already refunded to the treasury, Government will hereafter draw from the improved districts £100,000 a-year, or two-thirds of the whole sum originally expended of net increase of revenue. The increase of the land-tax is a small fraction of the actual gain. The native goods exported by sea from the irrigated districts sprung up at once from £70,000, their previous average, to £130,000 ; and though the tremendous floods of 1849 reduced them, they now promise to maintain themselves at above £140,000. Before this much could be contributed to the public purse, at least five times as much must have been taken out of the soil by the cultivators—expended probably on their own sustenance, partly devoted to the purchase of such luxuries as they could not previously afford, and in part it is to be hoped set aside as accumulated capital, but all constituting the solid and substantial wealth of the State. We probably do not overrate the fruits of the expenditure of £130,000, at a half million sterling annually in all ; representing at 5 per cent. a permanent capital of ten millions added to the value of our empire ; or a return of 400 per cent. annually on the adventure.

The work of Colonel Cotton, chief engineer, Madras, published a few months since, furnishes facts still more extraordinary. He says that from a return of forty works for irrigation, executed within fourteen years, the Madras government derive a net average return of 70 per cent. annually ; that in the published returns this is taken from the immediate completion of the works before they had begun to yield their full amount of fruit ; that they must at the present date be producing 100 per cent. annually, at least. This does not, however, include the improved returns from incidental sources, or the increased value from private property, which will probably bring up the whole to 200 per



cent. He astounds us with a statement that the water which runs off in waste from every square mile of a country of above a million of square miles, and at the charge of 2s. per 500 cubic yards, is worth £400 per year, or £400,000,000. That the people of India, averaging at present about a hundred per square mile, would be quadrupled were irrigation general; and that with the increase in the population that might be looked for, our revenues might be raised from £20,000,000 to £600,000,000 annually. Without venturing to contest the statements of so high an authority, we may for the present content ourselves with the assumption of one-tenth of the gains here set down, and assigning half of these to the Government, and half to those who may hereafter work the mines, hitherto so much neglected, we shall have £30,000,000 sterling of direct return, at the rate of 10 per cent., on a capital of £300,000,000 invested by the people of this country in Indian irrigation. These sums seem large; their expenditure is only contemplated over a considerable period of years; they fall greatly short of the amount within the last twenty years invested in railways in Europe, and give assurance of at least four times the return.

Amongst sums so enormous, our own adventure, destined not the less in all likelihood to be the parent of all the gigantic enterprises, and the pioneer to all the stupendous wealth to which I have just referred, will appear a very humble and very insignificant affair. We propose commencing with a capital of £500,000, the greater part of which we conceive may be invested in Scinde alone, at a profit of from 10 to 20 per cent. But though commencing with this for the sake of definiteness, we shall be quite ready to increase our capital, and extend our operations to any amount that may be deemed desirable; and we shall rejoice to see others entering along with us on kindred fields of labour, sufficient both in extent and fertility for all the husbandmen that can, for the present, be induced to resort to them. So soon as the facts already enumerated were available in an authentic and unquestionable form, I set about an agitation for canal irrigation by private enterprise, and published an outline of the scheme in the *Bombay Times*, more than a year ago. It so happens, however, that whereas British capital and enterprise can be enticed into any part of the world, however distant or unconnected with us, into any kingdom or amongst any people, however remote, uncongenial, or little known—by no amount of assurance, short of an absolute guarantee from Government, and by no extent of promise, however brilliant, or of attraction, however strong, can it be induced to seek an outlay in British India. The statements I have quoted are none of mine, they were not prepared for publication, they have been

drawn up by the most distinguished members of that most illustrious body of men, the Engineers of the East India Company, for the express information of Government; and the only explanation that can be given of their not having been turned to account is, that Government must have felt its hands encumbered with the administration of affairs, its time and attention distracted by those stupendous wars, in which for two centuries it has been almost unceasingly engaged, and by a cumbrous and complex system of organisation, by a force of circumstances, rendering it unable to meet the exigencies of the occasion. This is not the time to enter into explanations or discussions of these subjects; no trace or taint of politics whatever, of any form or hue, attaches to our scheme. We are content with the facts as they stand, which no man disputes, and with the circumstance that, as they have hitherto stood so—but for the intervention of private enterprise and pressure from without—they must continue to stand. We find fault with no one, and are willing to suppose that the resources of India have hitherto been neglected by its rulers, under the pressure of an inexorable destiny. On the grounds of the want of confidence of the British capitalists in investments in India, it is proposed to apply to the Court of Directors for a guarantee of a minimum interest of 5 per cent. on the capital invested, on the principle on which this has been conceded to Indian railways; the interest to fall due from the date of the first calls being paid up. To relieve the Court, however, of the slightest risk of being ever called upon to meet any payment at all on account of the guarantee—excepting that made while the works are in process of execution, and which will be repaid them when our sluices are opened and our revenues and theirs begin to come in—the guarantee will only be required over those districts which their own engineers report likely to yield a return of 7 per cent. at least. Thus shaped, and the Court thus guarded, our request assumes the simple form of a permission to cut canals in the country, which, for every shilling they will yield us, must yield Government half-a-crown at least. We propose interfering with no existing law or arrangement; we simply ask leave to secure premises and open shop as Water Merchants, accommodating any one desirous of being supplied on the terms which we deem most desirable, making all our own arrangements and laying no claim to privilege or monopoly. We feel perfectly confident that, before our works have been five years in operation, capitalists will view fields of enterprise such as these, with as much interest as they now regard them with indifference, and that no one will hereafter dream of speaking of a guarantee, which, as concerns

the adventurers is superfluous, as concerns the Government—a vision. We readily admit that the profits we expect to secure, would, to a considerable extent, accrue to Government themselves, were they to cut the canals with as much celerity and economy as individual adventurers (under the stimulant\* of personal advantage and enormous gains), will cut them. But not only does the same machinery exist under which past neglect has obtained, but the very same men remain in office; and to suppose that matters would go on more rapidly hereafter than heretofore, would be to assume that the delays of the past were voluntary, instead of arising from the force of circumstances, that the blame of them rested on the shoulders of individuals in place of being imputable to a system. Every year we postpone the construction of works that promise to yield enormous profits; we sacrifice sums we otherwise might have realised, and, basing our assumptions on official documents, we feel confident that, through the celerity with which our plans will be carried into effect, we shall be the means of putting much larger sums annually into the pockets of Government by the improvement on the land revenues alone, than they could put into their own pockets under their more tardy system of advancement, were all the sources of return open to them together. But though we, as a Company of Water Merchants, confine our consideration strictly to questions of gain from a single division of enterprise, and leave considerations of politics and philanthropy altogether out of view—as a body of English gentlemen we cannot lose sight of the fact, that the direct advantages our scheme will confer on India, and which will be equally conferred by a similar scheme worked out with similar celerity by Government, were such a thing conceivable, is but a small fraction of the good promising to accrue from it, and that that good is only likely to accrue should it be carried out by private enterprise. It is a constant complaint on all sides, and it is one which is perfectly well grounded, that while India abounds with a quiet, temperate, orderly, ingenious, and industrious population—that where its supplies of water are abundant, its soil beyond conception fertile, its productive resources everything to be desired—that everything lags and lies asleep from the want of Europeans, or people of capital, energy, or determination, to stir up and take advantage of the latent resources of the land; and nothing can be conceived more calculated than canals of irrigation, the property of individuals deeply interested in their progress, in their results, and their success, to remove the evil every one perceives, but for which, no one has hitherto been able to suggest a remedy. Within a couple of miles on either side of the canal, we propose to construct

from the Indus to Hyderabad, if there be any truth whatever in the assertions of Dr. Royle—and I see no reason for questioning their accuracy—fibrous plants of the finest quality could be raised under European supervision, to take the place of all the flax and hemp the Russian war deprives us of, and at more moderate terms than these can be procured in the Baltic. Who would not view it as a just and desirable dispensation, if one of the first rewards that England received for the sacrifice she is now making, one of the first results of the frightful calamities in which Nicholas is so needlessly involving the world, were the allurements to India of one of the most important and profitable divisions of our commerce, and the permanent estrangement from Russia of that trade which affords him the chief part of his revenues, and enables him to maintain the armies at present engaged in disturbing the peace of mankind. The mode in which we propose to carry our purposes into effect will be indicated by the resolutions brought forward by the gentlemen now present, the bulk of the details must be left to after consideration. Having organised a provisional Committee, leaving the permanent mechanism to be arranged by the copartners, after a sufficiency of stock has been disposed of, we propose applying at once for the *sine qua non* of a guarantee under the conditions just explained. A promise of this once obtained, some one will be nominated to press on matters at Bombay and to proceed to Scinde, and see the survey carried through, and the reports prepared to enable the Court to give their final unconditional answer; and with such men as the Marquis Dalhousie and Lord Elphinstone at the head of affairs; such men as Mr. Frere as Commissioner, and Major Turner as Chief Engineer in Scinde, and an active individual on the spot to assist them and urge them on, I see no reason why we should not have a report back again from Bombay by Christmas. Dr. Buist, in conclusion, said that he would not have ventured on statements so astounding as these, upon authority of less weight than that of the most distinguished body of men, the Engineers of Government. And he would have scarcely ventured then even on such authority before men who had not been in India. But when he saw in the chair the Superintending Engineer of the Deccan, a man whose name was well known to science in this country, as it had always been distinguished in India—when he saw near him a late member of the Madras Government (Mr. Sullivan); a Bombay Revenue Commissioner, devoted to the improvement of the country (Mr. Williamson Ramsay)—when he saw beside him the author of one of the earliest and by far the most attractive works on Scinde we yet possessed (Dr. Burnes); and the

officer selected from the whole of the Bombay Services by the penetrating eye of Sir C. Napier for the administration of the newly acquired Hyderabad territories (Captain Rathborne)—when he saw Major French, one of the earliest and most earnest writers on Scinde irrigation, and whose knowledge of Western India and its people was unsurpassed; Mr. Inverarity, a gentleman who, as collector both in Scinde and Candeish, had distinguished himself by his knowledge of the country and his anxiety for its improvement; and Captain Evans, one of the favourite pupils of the late illustrious governor of the North-West Provinces—he felt confident that what he had said would not only be assented to but acknowledged to be a long way within the fact.

Mr. SULLIVAN said, he hoped it would be fully understood by the public, to whom we appealed for co-operation in this glorious undertaking, that the data on which Dr. Buist had based his exceedingly moderate estimates of profits, had been furnished by the officers of the East India Company, and were endorsed by the authorities both in India and in England. As had been observed, the profits of irrigation under the Madras Presidency, which had in some instances been 140 per cent., were never less than 30 per cent.; and to illustrate the large returns that irrigation was assumed to secure, the Government never entertained any scheme which did not, on the estimate of their own engineers, promise a return of 15 per cent.

Dr. BURNES, K. H., late Physician-General of the Bombay Army, moved the second resolution. He observed, that the present proposal reflected much credit on Dr. Buist, whose active energies and ardent temperament he was rejoiced to see directed to such noble and important objects:—they might well be called so, for, if crowned with success, they would carry blessings to vast multitudes of people. The scheme appeared quite practicable according to the opinions of safe and intelligent men, who had held high places as engineers and revenue servants in the public service of India, such as Colonel Grant, now in the chair, and Captain Rathborne. The latter had a perfect practical knowledge of the district in which it was proposed to commence operations, while Colonel Grant's support was, beyond measure, valuable on account of the well-known scientific ability for which he was so conspicuous during his long service at Bombay. It was more than a quarter of a century ago since he (Dr. Burnes) had ventured to prophecy what Scinde then, almost a *terra incognita* to Europeans, would prove under the influence of British capital and enterprise. He had been employed nine or ten years of his life at the political residency in

Cutch, on the eastern branch of the Indus, and within a short distance of the locality where Dr. Buist proposed to cut his canals, and could tell from personal experience the wonderful effects produced in those countries by the introduction of water. Some present would probably recollect the account given by his brother, Sir Alexander Burnes, of the disastrous effects produced on Cutch by the withdrawal of the waters of the Indus from it in the middle of the last century, when the then ruler of Scinde, having been defeated by the Prince of Cutch, revenged himself by directing the water which passed to his canal into another channel, thereby depriving his adversary of nearly half his revenue, and transforming a valuable district of rice country, sufficiently peopled, into a gloomy and unproductive waste, which it has been ever since. The resolution he had to propose had reference to requesting the support of the Directors of the East India Company, and soliciting from them a guarantee of 5 per cent. on the capital advanced. This he thought an indispensable preliminary.

Captain RATHBORNE, though in no way directly interested in this scheme, having been appealed to by Dr. Buist, had no hesitation in expressing his cordial concurrence in all that had been said respecting the profits of the projected undertaking, and the inconceivable benefits it would confer on the country. To give an illustration of the fertility of the soil of Scinde, he need only mention that 56 bushels of wheat was a common return per acre. The land was found to improve in quality as you receded from the river. Much of the country in the Hyderabad collectorate was held in *Jagheer*; and the Jagheerdars would hail with pleasure the formation of such a company, and cordially co-operate with it, as he had no doubt would the Scinde government; for the existing arrangements in respect of "water rent" and "land rent" were such as to afford great facilities for the distribution of the water and security of returns.

Major FRENCH pointed out a large district of rich fertile land in the Valley of the Taptee, affording a fine field for irrigation and lying wholly unoccupied, which he would like to see taken in hand should the Company extend its operations to Guzerat.



## A P P E N D I X.

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[FROM THE TIMES, DECEMBER 29, 1853.]

India has so often changed hands, so often been the object of far-sighted ambition and sudden conquest, that even under the strong and stable rule of this country the question often occurs—when will the next change come? Who will be the next lords of Ind, what nation will cross the Indus, or sail up the Hooghly? What subsidised dynasty will supply the pretender who shall suddenly gather legions, as if from the cloud of heaven or the dust of the plain, and, sweeping like a tornado over all the barriers of British dominion, make that great peninsula his own? History bequeathes the lesson, and not a throne has crumbled in the dust without an ominous memento to the conqueror of what he, too, may come to. The presentiment is felt, and scarce a cadet lands at Calcutta without the occasional reflection that he may live to see the end of that City of Palaces. How, then, do we stave off that gloomy idea, and assure ourselves that India is safe? In many ways. We sustain splendid establishments. We keep up great armies. We dazzle the eyes of the natives with our magnificence, and enforce their respect with our truth and honour. We are perpetually advancing the frontier, augmenting the *prestige* of our name, and securing what we have by conquering what we have not. As long as the empire grows it will live, we are told, and we need not disturb ourselves till it stops growth. Whatever confidence we may have in the preservative powers of perpetual victory, there is one preservative stronger than any succession of costly and barren triumphs. Make the people prosperous and happy; clothe the land with fertility; appear everywhere as the good genius of the soil; cover it with works such as none but the British could accomplish, and none but they maintain; let the health, wealth, and lives of millions depend upon the continuance of our rule—then we shall possess a hold over the population strong enough to break this formidable prescription of perpetual change. The secret of power does not consist in depressing the energies and corrupting the souls of the subject population by luxuries or by show. Make the people industrious, peaceful, calculating, and regular, and they will be the last to give up houses and lands, children and servants, returns of trade, and succession of crops, merchandise, cattle, banks, and all the machinery of civilised life, for war, devastation, anarchy, massacre, and ruin, or whatever other evils to body or soul may be expected when a country is once given up to the arbitrament of the sword.

How little this great palladium of empire has been considered hitherto, how much remains to be done, and how, even now, idle dreams of conquest are permitted to displace the more solid works of improvement, has often been deplored in these columns. Now is the time to urge these considerations with more chance of an effectual result. The British Government is



now on a more efficient system; we seem to be at length seeing our way through the Burmese war; there is no new province to be won, no foe to be chastised,—only here and there a hill robber to be reduced, and nothing remains to be done that requires any increase or extraordinary operations of the army. Money is abundant, and our Indian correspondent informs us that the Government is actually paying off old loans at 5 per cent., with new loans paying only 3½. Now then, if ever, is the time for setting about some of those splendid works of irrigation, on which the prosperity of many districts absolutely depends, and the profit of which has so often been demonstrated. This very year is likely to contribute new and sad testimonies to the necessity of these works. Extensive districts under the Bombay Government are seriously threatened with famine through the failure of the monsoon. The little rain that fell soon passed away, and was not husbanded, as it might have been, in tanks and canals. Wherever water is the one necessary of cultivation, its effects admit of being calculated with the utmost exactness. Every degree on the Nilometer indicates just such an amount of produce, neither less nor more; and, although at first sight it may seem that the water diffused through a vast system of canals following the line of the hills, cannot produce such certain results as a general inundation like that of Egypt; yet, so it is: we believe that a practised engineer will tell how much a certain quantity of rain in a given Indian district will contribute to the harvest. That countries which have formerly enjoyed the benefit of irrigation conducted with great care, and have in their day been productive and prosperous, may become poor and degraded, through the neglect of those means, we have signal instances in the present condition of Syria and the banks of the Tygris and Euphrates; rivers that to this day show the remains of the great works designed for the irrigation of the neighbouring districts. Any ordinary engineer practised in these works would be able to calculate how much of the last monsoon rushed unprofitably to the sea, how much was retained and turned to account by nature itself in its own beds and reservoirs, how much more might have been arrested in canals and tanks, how much more it would have contributed to the crops of every acre, and how many lives it would have saved from the most dreadful, because most lingering, of deaths.

It is quite obvious, on the slightest consideration, that the cost of wars and conquests, so often alleged as the reason for neglecting these public works, need be no obstacle at all. There is no country which spends so much in military and naval establishments as this that we live in, nor is there any in which so much is also spent in developing all the wealth and resources of nature. Wherever there is a certainty of increased production, there is a prospective revenue which admits of being capitalised, and for the development of which capital can be obtained to any reasonable amount. Let the Indian Government only offer facilities for British enterprise, let it only allow British engineers to calculate the profits of irrigation, to collect the tolls and rents for the supply of water, and all the apparatus necessary for handing over a good dividend to the shareholders, and, no doubt, there are plenty of people who, without any particular love for India or the human race, will be only too glad of 6 or 7 per cent.

from India instead of 4 per cent. from railways, 3 per cent. from Consols or 1 per cent. from land in this country. Such arrangements are wholly irrespective of wars, whether on the Indus or the Irrawaddy. The transaction will be between the British capitalist and the Indian cultivator, and so long as the latter gets better crops the former will get his dividend, and all will be richer. When, indeed, we are told that such and such works have been stopped or neglected because the Indian Government found it necessary to apply the funds to some war in progress, we can only say it is a very great pity that any government liable to such temptations and, interruptions had the management of those works. The only parallel to such an absurdity would be, the almost inconceivable case of the British Government at home having the management of the railways, and applying to the building of war steamers, or to fortifications in Corfu, the money that ought to have been spent in replacing the rails and locomotives, keeping up the permanent way, and paying the railway porters. The obvious remedy for such an abuse would be, to take the railway forthwith out of the hands of a government whose right hand proved dishonest to its left, and to consign the office to a body of administrators whose only business it should be to manage the railway, receive the proceeds, do the necessary works, and hand over the excess of profits to the shareholders. We trust to see the day when, instead of Australian land or gold companies, or South American mines, we shall see in the London Share List the names of Indian irrigation companies, guaranteed, not their profits, but the peaceable management and control of their affairs, by the Indian Government. In that way wealthy England may at last prove a blessing to the immense and most interesting population which Providence has subjected to her rule, and the poor Hindoo may at length be able to speak of England as a minister of Providence.

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[FROM THE LONDON MAIL, OF MAY 9.]

THE past three issues of the MAIL have contained allusions to a scheme for the irrigation of certain portions of India, which has at length been brought before the world by its originators and promoters. In another part of our paper will be found a report of the proceedings of a meeting held in the City on the 29th ultimo, which, considering it was merely preliminary, and summoned by circular only, was everything in point of numbers and respectability that could be desired.

Of the 15 gentlemen whose names are given as having been present, 13 have long been residents in India, and their names have been long well known to the world. More than half of them have held distinguished places in the public service. The outline estimate of expenditure and returns which we have published, is, we are informed, not to be accepted as rigidly accurate. It is still under the revision of some of the ablest members of the corps of engineers, who have been engaged in irrigation operations in India; and even when it has passed from their hands it must be received with reservation until tested by the actual survey. We make these statements on the assurance of the parties themselves; and we like, above all

things, the candour and the caution with which they are proceeding. As matters stand we have margin enough for vast deductions, without reducing profits beneath the figure that may well be regarded as enormous. The cost of their works is in reality considerably greater, in proportion to the task assigned to them, than that of the great Ganges Canal, which, on an outlay of a million and a half, secures a discharge of eight thousand millions of cubic yards of water annually. All that is expected from the Soinde Canal is two thousand millions of cubic yards of water, for an expenditure of half a million sterling. In round numbers, and without troubling ourselves with details, this will afford a return of above four hundred thousand pounds sterling, or eighty per cent., if the water be sold at one rupee per 500 cubic yards, the price allowed for it by Government in all parts of India.

These results, it must be remembered, fabulously enormous as they seem, are in the most perfect accordance with the past experiences of Government, and they have been attained by the most infallible means, through the most competent authorities. We have no doubt that whenever it gets into the hands of the engineers on the spot, liberal deductions from the income, and additions to the expenditure, will be made, and this is all quite right and reasonable; but if the former be halved and the latter doubled—and surely this will more than cover all—we still have twenty per cent. remaining of free available dividend, guaranteed never to fail under five per cent. We have felt disposed to blame the company for not more speedily promulgating the names of their office-bearers, and appointing their agents for India; but this we learn has arisen from a cause eminently commendable. At the meeting, Alderman Kennedy, Colonel Grant, Mr. Francis Carnac Brown, and Dr. Buist, were named as a committee to make arrangements, and office-bearers will only be selected after half the stock has been disposed of, and a constituency to elect and select from has been brought into existence; and the matter affords a striking and honourable contrast to the scramble we usually see made by those who first launch a scheme into the world for a monopoly of its appointments.

Scrip will be issued for 50,000 £10 shares as soon as the estimates have been completed for publication, and applications may meanwhile be made to any one of the gentlemen just named.

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[FROM THE ATLAS, OF MAY 9.]

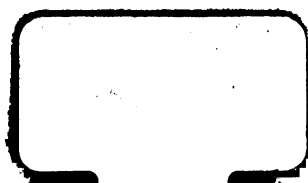
We have been for so many years accustomed to hear complaints of the want of public improvements, and the deficiency of European enterprise in India, that it is with no small degree of gratification that we at last perceive work likely to take the place of words; the complainers, themselves, setting their shoulders to the wheel, and endeavouring to provide that which all confess to be most particularly desired. In another portion of our paper will be found a short report of a meeting, for the purpose of forming a Canal Irrigation Company for India; and while nothing could be more desirable than its success, few things seem more probable than that it will succeed. It appears to be supposed that in the present state of the money

market, there seems no chance of raising capital sufficient without a guarantee of 5 per cent. interest from the Court of Directors; and while we have no doubt whatever that the Court will at once concede this under the conditions proposed, that it will only be asked for in the event of the Government engineers reporting a minimum return of 7 per cent., we feel by no means certain that the guarantee will be found requisite. Nearly every man present at the meeting had served in India, and was perfectly qualified to judge of the question; all concurred with one accord that Dr. Buist's estimate of 20 per cent. was in the least degree moderate, and if a dozen or two of retired Indians choose to head the share list, capitalists will take the guarantee of their names without troubling the Court, and thus avoid those delays, trammels, and interferences, which a too close connection with Government always occasions. It is proposed to commence with the investment of half a million to begin with; but this it is considered very likely to be but the commencement of a hundred kindred schemes promising the investment of millions and millions, at profits such as have never hitherto been realised. The results, indeed, that might arise from the full irrigation of India, almost exceed the imagination in value; if the Company's engineers are to be believed, and we see no reason to question their authority, the revenue might almost be doubled by them, and dominions thus virtually added to England, equal in returns to that empire now pronounced the brightest jewel in the Crown.











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